DOCUMENT RESUME

ED 224 715 SE 039 839

TITLE	Mathematics and Young Children: Discovery through Exploration.
INSTITUTION	Kentucky State Dept. of Education, Frankfort. Div. of Program Development.
PUB DATE	80
NOTE	87p.
PUB TYPE	Guides - Classroom Use - Guides (For Teachers) (052)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	*Discovery Learning; Elementary Education; *Elementary School Mathematics; Guidelines; *Kindergarten; *Learning Activities; Learning Theories; Mathematics Curriculum; *Mathematics Instruction; State Curriculum Guides; Teaching Guides; Teaching Methods
IDENTIFIERS	*Kentucky State Department of Education; Piagetian Theory

ABSTRACT

The document has three major components: (1) rationale; (2) content; and (3) activities. The rationale, which deals with considerations and methods for teaching mathematics concepts to young children, is provided through the following articles: (1) "Piagetian Implications for Kindergarten Mathematics Instruction"; (2) "A Rationale for Organizing and Integrating Math Activities in the Kindergarten Classroom"; (3) "Developing Logic and Reasoning Skills in Young Children"; (4) "Assessing Mathematics Behavior in Kindergarten"; (5) "Spatial Relations and Young Children"; and (6) "The Interplay of Math Activities and Pre-Reading Skills for Young Children." The above items form the theoretical basis for the activities and ideas. The content is given in the format of a sequential listing of mathematics skills, which provides the framework for the activities. Activities are divided into pre-number, geometrical, number, measurement, graphing, time and money, fractional, and operational. The document is not designed as a comprehensive program, but rather as a sourcebook for teachers and administrators. It provides the rationale and activities for developing a discovery-based mathematics program. (Author/MP)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED224715

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Donna Swanson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

SE039839

MATHEMATICS

AND

YOUNG CHILDREN:

DISCOVERY THROUGH EXPLORATION

1980

2nd printing 1983

Division of Program Development
Bureau of Instruction
Kentucky Department of Education

Raymond H. Barber
Superintendent of Public Instruction

Paid for with State Funds.

FOREWORD

The requests from kindergarten teachers and administrators for curriculum materials relative to mathematics educators have prompted the development and dissemination of Mathematics and Young Children. A product of contributions made by educators skilled in the teaching of mathematics to young children, the booklet provides the rationale and activities for developing a discovery-based mathematics program.

Appreciation is expressed to those involved in preparing this booklet which should serve as a useful resource for kindergarten teachers and administrators.

Raymond Barber
Superintendent of Public Instruction

PREFACE

Mathematics and Young Children has three basic components: (1) rationale (2) content and (3) activities. The rationale, dealing with considerations and methods for teaching mathematics concepts to young children, is provided through seven separate articles prepared by local educators. These articles form the theoretical basis for the activities and ideas.

The content is given in the format of a sequential listing of mathematics skills. This listing provides the framework for the accompanying activities.

Those who utilize this booklet will note the emphasis on self-discovery, concrete activities and a variety of sensory experiences. This emphasis is in keeping with the developmental level and learning style of the five-year-old child.

Mathematics and Young Children is not designed as a comprehensive math program, but rather as a sourcebook for the teacher and administrator. Contributors to the development of the publication trust its contents will be helpful in developing quality mathematics programs for young children.

For further information contact:

Cathy Crum, Program Manager
Early Childhood Education
Division of Program Development
Capital Plaza Tower
Frankfort, KY 40601

ACKNOWLEDGEMENTS

Appreciation is expressed to the following individuals for their contribution to the development of this publication.

Dr. Joseph Baust
Department of Instruction and Learning
Murray State University

Renee Prillaman Coates
Kindergarten Teacher
Wellington Elementary
Jefferson County Schools

Dr. James Davidson
College of Education
Eastern Kentucky University

Kay Wright Springate
Department of Home Economics
Eastern Kentucky University

Ellen Schlafer
Kindergarten Teacher
Okolona Elementary
Jefferson County Schools

Dr. Charles Thompson
Department of Early and
Middle Childhood Education
University of Louisville

Dr. Diana Wearne
Department of Curriculum and
Instruction
University of Kentucky

Appreciation is also expressed to Linda Harlow, Conley Manning, Lydia Sledge and Burdell Swain, readers of the compiled manuscript and to Minnie Masters and Donna Lewis, typists.

TABLE OF CONTENTS

Foreword.....i
Preface.....ii
Acknowledgements.....iii

CONSIDERATIONS FOR THE TEACHING OF MATHEMATICS

Piagetian Implications for Kindergarten Mathematics Instruction

Dr. Charles Thompson.....1

A Rationale for Organizing and Integrating Math Activities in the Kindergarten Classroom

Renee Prillaman Coates and Ellen Schlafer.....10

Developing Logic and Reasoning Skills in Young Children

Dr. James Davidson.....12

Assessing Mathematics Behaviors in Kindergarten

Dr. Diana Wearne.....14

Spatial Relations and Young Children

Dr. Joseph Baust.....19

A Rationale for Teaching Measurement and Graphing

Renee Prillaman Coates and Ellen Schlafer.....26

The Interplay of Math Activities and Pre-reading Skills for Young Children

Kay Wright.....28

A SEQUENTIAL LISTING OF APPROPRIATE MATHEMATICS SKILLS FOR YOUNG CHILDREN.....31

MATHEMATICS ACTIVITIES

I. Pre-number Activities.....33

II. Geometrical Activities.....43

III. Number Activities.....49

IV. Measurement Activities 53

V. Graphing Activities..... 60

VI. Time and Money Activities..... 62

VII. Fractional Activities..... 64

VIII. Operational Activities..... 66

Resources..... 68

Appendices

Appendix I: Equipment Appropriate for the Kindergarten Classroom..... 70

Appendix II: Sample Objectives for a Kindergarten Math Program..... 71

Appendix III: Skills Continuum for Kindergarten Disseminated by the Kentucky Department of Education..... 72

CONSIDERATIONS

FOR THE

TEACHING OF MATHEMATICS

Concrete or Abstract???

Structured or Non-structured???

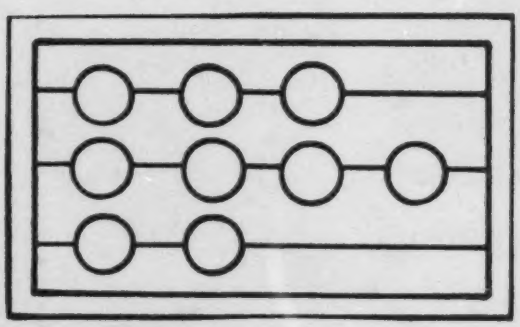
Assessment???

Workbooks???

Organization???

Metrics???

Grouping???



Piaget and Kindergarten Mathematics

Dr. Charles Thompson

Recently, the ideas of Jean Piaget have been cited to support teaching practice in kindergarten classrooms. Much of the philosophy of the open classroom, the informal classroom, and the British infant classroom has been linked to Piaget's findings about how children learn. With regard to the teaching of mathematics to young children, the ties with Piaget are even closer. The Nuffield Mathematics Project, a mathematics curriculum project for young children, is dedicated to Jean Piaget. Many mathematics educators (e.g. Biggs, Copeland, Lovell, Adler) have examined mathematics teaching in light of Piaget's findings and have written about the implications of those findings for mathematics instruction. Speaking for many mathematics educators Lovell states, "I believe that his position regarding the acquisition of certain kinds of new knowledge is of more value to the mathematics teacher than any other position at the moment . . . (1972, p.2)."

This paper summarizes the results of Piaget's research about how children learn and examines the implications of that research for kindergarten mathematics instruction. The underlying philosophy is that teaching practice should be consistent with what is known about how children learn. For purposes of analysis, relevant Piagetian research has been separated into four topic areas: 1) the sources of knowledge for children, 2) the uniqueness of learning, 3) the nature of motivation, and 4) the value of social interaction.

The source of knowledge for children is their physical action with concrete objects. This is one of Piaget's most basic tenets. He writes, "Mathematics is, first of all and most importantly, actions exercised on

things, and the operations (e.g. addition, multiplication) are more actions . . (insert mine)/ (1972, p. 103)." He believes that cognitive development arises out of the activity of the child with concrete materials. Children manipulate the materials and learn from them. The implications of this result for the kindergarten mathematics teacher are far-ranging. First and foremost this result indicates that work with concrete objects should precede work with pictures or symbols (numerals) which represent those objects and also that work with objects should precede work with symbols which represent actions on those objects (e.g. addition). It also indicates that manipulation of spoken or written symbols cannot replace the child's actions in the construction of knowledge. The children themselves must make the abstractions from the concrete objects before they use pictures or symbols referring to those objects. This emphasis on action runs counter to the practice of teaching mathematical concepts verbally. The mathematics which can be taught verbally is limited to those skills which need not be abstracted from objects, such as the sequence of number words one, two, three, four, and so forth, and other arbitrary conventions like naming the joining of sets "addition" rather than some other term. However, number concepts (which are often taught verbally) must instead be built by the child by constructing relationships on sets of concrete objects. For example, in order to understand the concept of "threeness" a child must be able to mentally order the objects in a set of three objects and be able to mentally restructure a set of three objects to perceive included with it a set of 2 objects and with the set of 2 objects a set of 1 object (see Kamii and DeVries, 1976).

Another practical implication of Piaget's emphasis on activity with physical objects is the inappropriateness of the use of workbook pages for

the bulk of a kindergarten mathematics program. Workbook pages often cause children to acquire incorrect ideas about mathematics. One of the common workbook pages has children draw lines, one at a time, from pictures of objects in one set to pictures of objects in another set. Then the children are to draw an "X" on the set with pictures left over. Supposedly this exercise has children compare sets by using one-to-one correspondence. Instead, children may learn to draw the lines routinely without quantifying the two sets. They may obtain the right answer but for the wrong reason. They may or may not have the slightest idea about which set has "more." Contrast this task with one in which the child is asked to bring enough straws for everyone at his or her table. Here the child must construct the set, beginning with zero objects, and then decide when to stop. The child may or may not count when solving the problem, but the child is active and must quantify the sets. And, what is learned is a result of actions with concrete materials.

A further implication of the idea that children must be actively involved with concrete objects is that children can not build meaning and comprehension of mathematical symbols simply by manipulating those symbols. For example, children do not learn the meaning of addition by completing paper and pencil exercises like 2+2=☐. As evidence, Steffe and Van Engen (1966) found that even though almost all of 100 first grade students could correctly work exercises like 2+3=☐ and 4+5=☐, only 54 of them could correctly state no preference when offered (1) a single group of 5 candies or (2) two separate groups of candy totaling 5 altogether. Thus, even though these children could solve addition problems presented symbolically, they could not solve similar addition problems presented concretely.

To summarize the implications of Piaget's emphasis on acting on objects, the following guideline for teaching is suggested: "Physically active involvement should characterize the children's work in mathematics . . . From the manipulations and observations come the abstraction of quantitative ideas and the communication of these ideas in pictorial or symbolic form (Cruikshank, 1979, p. 1)."

A corollary to the idea that children learn from their own activity is that what they learn is unique to them. Children construct their own knowledge and the picture they paint of reality is theirs alone. Then, as children have more and more experiences, their pictures of reality become better and better approximations of reality itself. One implication of the idea that cognitive development is an individual affair relates to providing feedback to children. It is imperative that teachers find out how children are thinking so that the feedback they provide is appropriate. This suggests that teachers listen carefully to children and observe them while they are working with objects. In this way the teacher can determine the reasoning processes the children are using and carefully correct the processes rather than simply correct the answers. One example which frequently arises in kindergarten occurs when a child distributes materials. Often he or she selects a set of materials which has 1 less object than is needed to go around. A casual question asking whether or not the distributor included himself or herself when selecting the group of objects to bring may cause the child to correct his or her reasoning process. In fact, the teacher's question may help the child restructure his or her picture of reality-the true cause of the incorrect reasoning.

The next topic to be discussed is the nature of motivation. According to Piaget the only motivation that relates to substantive learning is intrinsic motivation. He believes that intrinsic motivation occurs when a child experiences a "need to know." This "need to know" results when an impinging idea or event does not fit into a child's cognitive structure. The child experiences a disequilibrium and the desire to return to equilibrium is the motivation to do so. The implications of this result are manyfold. First, it suggests that the materials that a teacher places in the classroom are important. Children interact with the materials and interaction with appropriate materials can cause children to experience disequilibrium. For example, a child who is on the borderline of learning that rearranging a set does not change the numerousness of the set may experience disequilibrium when he or she is given two sets of objects, both having the same number of objects but one set containing much larger objects, and asked to determine if one set has more members than the other. Choosing materials (and tasks) which may cause disequilibrium to occur is difficult. It requires that the teacher understand cognitive development and listen carefully and observe children to determine what concepts they are developing. Only then can he or she select materials and tasks which may motivate the children (that is, cause disequilibrium). In general, the teacher should select materials and tasks which embody characteristics of the concept the child is developing but which also have connections to the concepts already known by the child. Whether the materials and tasks motivate the children or not, however, is determined by the children. Elkind writes," . . . intrinsic motivation resides in the child and not in the methods and procedures (or materials). It is the child who must, at any given time, choose the method of learning and the materials that are reinforcing to him (1971, p. 25-6)."

A second implication regarding motivation for learning relates to the structuring of activities and the use of time. Because children intrinsically know what they are ready for, since they are the ones who experience disequilibrium, they need to be given choices about what activities they do. Further, they need to be given large blocks of time within which to work. Applied to mathematics, this suggests that teachers create "interest areas" where children can work on their own for long periods of time. Also, children should do math whenever they feel a need and an interest rather than at a fixed time. Math concepts should be explored whenever they arise in the kindergarten classroom, and they arise frequently and naturally in the everyday events of the 5 year old. Some examples are: distributing materials, dividing things, collecting things, keeping records, voting, singing and making music, and playing games.

To summarize, Piaget rejects the notion that external motivation can be an effective stimulus for substantive learning. Instead, he states that intrinsic motivation must be the impetus for such learning. The child is ready to learn something when sensitivity to that thing is present in the child's cognitive structure. That is, he or she is in a state of disequilibrium and his or her innate desire to attain equilibrium is the intrinsic motivation which causes him or her to pursue activities which will help reestablish equilbrium.

A fourth result of Piaget's research concerns the child's need for social interaction. Piaget points out that young children are naturally egocentric and that their egocentrism prevents them from considering viewpoints other than their own. However enabling children to recognize other points of view is a universal educational goal. How can this goal be achieved? The implication from Piaget's research is that children need to interact verbally with other children. With regard to mathematics, verbal interaction occurs when children are asked to verify answers among themselves. Then they

confront ideas which conflict with their own and are motivated to think about the existing problems again and then either revise their own ideas or argue for them. A teacher's role is to bring conflicting opinions to the children's attention and to have them resolve the differences. The conflicting ideas may cause disequilibrium to result for some children and the ensuing discussion may begin the return to equilibrium. An offshoot of the practice of having children verify answers among themselves is that the children develop confidence in their own abilities to decide which answers are correct and which ones are not. The children learn to depend on themselves and the teacher is not placed in therole of an authority. Another reason for having children interact with other children is that one child is often able to understand another child better than an adult can. Children's cognitive structures are similar and the words and actions that they use to communicate ideas to one another are readily understood. The implication is that children should be used to teach other children. The value of this activity is well established, both for the "teacher" and the other child. The child who teaches learns because the reasoning processes used are consonant with his or her own.

In conclusion, the results of Piaget's findings about how children learn have important implications concerning the teaching of mathematics to kindergarten children. If his findings were taken to heart, then children would learn mathematics by physically manipulating objects, by abstracting concepts from those manipulations and then by using symbols to communicate and represent those manipulations. The children would be given choices about the activities they pursued and time to complete activities that they initiated. They would verbally interact with their peers to decide the best approaches for solving problems and would sometimes teach other children. They would be motivated by the materials and activities which caused them to experience disequilibrium. The teacher's role would be to create a rich

environment and an atmosphere conducive to active learning. The teacher would structure the children's learning by directing activities and by placing materials in the classroom which would help the children develop mathematical concepts appropriate to their developmental levels.

If Piaget's findings were applied to kindergarten mathematics instruction, then the following description would no longer apply:

> In many schools, the elementary school child's mathematics activity takes place 99 percent of the time in his workbook, completing worksheets. What experience there is with concrete materials is usually limited to the child's watching the teacher demonstrate something . . . to the class . . . In such classrooms the primary 'activity' of the child is pushing a pencil or crayon over a page! . . . The overwhelming emphasis on working with numbers can lead the child to believe that mathematics is learning to manipulate numbers. (Wadsworth, 1978, p. 171)

Surely we can do better by providing active learning through the use of concrete materials in our kindergarten classrooms.

BIBLIOGRAPHY

Adler, I. "Mental Growth and the Art of Teaching." The Arithmetic Teacher (November 1966): 576-84.

Biggs, E., and MacLean, J. Freedom to Learn. Reading, Massachussetts: Adison-Wesley (Canada), Ltd., 1969.

Copeland, R. How Children Learn Mathematics. 3rd ed. New York: Macmillan, 1979.

Cruikshank, D.; Fitzgerald, D.; and Jensen, L. Young Children Learning Mathematics. Boston: Allyn and Bacon, 1980.

Elkind, D. "Two Approaches to Intelligence: Piagetian and Psychometric." In Measurement and Piaget, edited by D. Green, M. Ford, and G. Flamer. New York: McGraw-Hill, 1971. Pp. 12-28.

Kamii, C. and DeVries, R. Piaget, Children, and Number. Washington, D.C.: National Association for the Education of Young Children, 1976.

Lovell, K. The Growth of Understanding in Mathematics: Kindergarten through Grade Three. New York: Holt, Rinehart and Winston, 1971.

_____. "Intellectual Growth and Understanding Mathematics." Journal for Research in Mathematics Education 3 (May 1972): 164-82.

Nuffield Mathematics Project. I Do and I Understand. New York: John Wiley and Sons, Inc., 1967.

Piaget, J. To Understand is to Invent. New York: Viking, 1972.

Van Engen, H. and Steffe, L. "First Grade Children's Concept of Addition of Natural Numbers: Technical Report No. 5." Madison: Wisconsin Research and Development Center for Cognitive Learning, 1966.

Wadsworth, B. Piaget for the Classroom Teacher. New York: Longman, Inc., 1978.

Dr. Thompson is an associate professor in the Department of Early and Middle Childhood Education, University of Louisville.

A Rationale for Organizing and Integrating Math Activities in the Kindergarten Classroom

Ellen Schlafer and Renee Prillaman Coates

Mathematics is a part of every child's life and, therefore, practical application should be evident in the classroom. In developing a math curriculum for kindergarten, one must consider the basic developmental needs of the student. Although the attention span of the young child varies, one can expect a child to attend to a particular activity for approximately ten to thirty minutes. The activities must be concrete and appropriate to the child's level of experience. If workbooks are used, they must be preceded by, and often accompanied by, concrete materials. The child will communicate physically and will give cues as to when his or her attention span has expired. The teacher must then provide for the child's need for movement and variety.

The child's developmental level also dictates the need for variety in classroom organization. Math concepts should be taught through large group, small group, and center activities. An innovative teacher will look for ways to use math in all three modes of organization. Story-telling, movement, music, finger plays and introducing new concepts are worthwhile large group activities. Small group instruction, based on developmental levels, can include many of the same kinds of activities. But by using flexible grouping for skill development while the remainder of the class is at centers, the teacher has more opportunity to individualize instruction. Centers allow for an even greater amount of individualization and provide reinforcement and enrichment. The mathematics center is basic to every kindergarten classroom, but math should also be integrated into all other center areas which include:

blocks

housekeeping

science

language arts

arts

woodworking

manipulatives

sand and water

drama and music

Small group instruction and center activities can occur simultaneously in a well organized classroom with or without aides or parent volunteers. Everyday routines such as taking attendance, collecting money, and transition to new activities lend themselves to reinforcing and extending math concepts. The teacher should also use unexpected lapses in the schedule for instructional purposes. A short finger play reinforcing a particular concept is a valuable filler while waiting to be called to the assembly program. No opportunity for instruction should be missed.

Renee Prillaman Coates is a kindergarten teacher at Wellington Elementary in Jefferson County.

Ellen Schlafer is a kindergarten teacher at Okolona Elementary in Jefferson County.

Developing Logic and Reasoning Skills in Young Children

Dr. James E. Davidson

The traditional mathematics program is based on "number." Number is a mathematical abstraction which is very difficult for the kindergarten child to comprehend. A great assortment of concrete experiences will permit the child to gain physical knowledge of number.

Many children entering kindergarten are in a pre-number period, that is, they cannot really understand number at this time. A child may be able to count very well and may even be able to proclaim that there are four apples left in the dish and at the same time have no idea as to the meaning of "seven." Kindergarten is the time to provide extensive experiences with pre-number ideas, experiences with activities which lead to number and the understanding of number.

Sorting (classification) and ordering (seriation) are prerequisites to number. These activities give children physical knowledge of "things." Sorting and ordering "things" help children note facts about objects such as their color, whether or not they breathe, whether the objects are large or small, etc.

Ordering is the sequencing of events or sets of objects. Ordering objects by placing them one after another from largest to smallest, shortest to tallest, fattest to thinnest, lightest to heaviest, etc. is important readiness work for ordering numbers. Reverse ordering of objects is a pre-requisite for reverse order of numbers. Order is not fully understood by many children until age 6 or 7. Since order is so very important to the understanding of number a multitude of activities involving ordering of objects needs to be incorporated into the kindergarten mathematics program. Number is the synthesis of classification and ordering.

Classification is the sorting of objects according to characteristics which they do or do not possess, such as red or not red, circle or not circle, rough or smooth, etc. Classification involves a study of relations, that is, how things are alike or different. Logical classification is a basic intellectual activity and work with number should be preceded by much work with classification of objects.

Much of the kindergarten mathematics program should be involved with pre-number ideas using activities involving sorting, classifying, matching (one-to-one correspondences), copying patterns, and continuing patterns. Several examples of each of these are included in the activities section of this publication. Time spent on pre-number activities will pay off later with greater understanding of number.

Dr. Davidson is a professor of mathematics education at Eastern Kentucky University.

Assessing Mathematics Behaviors in Kindergarten

Dr. Diana C. Wearne

Kindergarten is a time for children to interact with their environment and with each other. Although a similar statement could and should be made for any grade level, a greater emphasis in the kindergarten is placed upon the child having a variety of experiences, experiences which will lay the foundation for mastering concepts rather than a set of experiences whose function is to lead to mastery of the concepts at the conclusion of the activities. We are less concerned at this level with mastering objectives than with assisting students in exploring their environment.

Obviously there are certain mathematical concepts we would like children to master while in kindergarten, objectives which are important for the child's growth in the first grade. However, it might be said the prime objective of mathematics instruction in the kindergarten is to expose the child to a variety of situations which will broaden his/her background. Developmental psychologists would tell us there are certain concepts which are beyond the understanding of many if not most of the children at this grade level. For example, we might infer from the writings of Piaget that children of this age are unable to conserve on a variety of attributes. However, it is possible to provide the child with opportunities which might involve the conservation of various attributes such as numerousness or length without expecting the child to perform at any given level upon the completion of these activities. This is not to imply we wish to provide "training" activities, merely that we wish to provide experiences which will enrich the child's background.

Another example of a category of activities which all children may not be able to do but which are important to include are activities involving sorting objects on one or more attributes. Again, developmental psychologists have indicated that sorting objects on two attributes, or even one, is beyond the capabilities of many five year olds and yet it is an important class of activities to include in a kindergarten mathematics program as it encourages children to describe objects and to note their similarities and differences; furthermore, it is considered to be a prerequisite for the understanding of the concept of number. All of the foregoing is to say we wish a kindergarten mathematics program to be a rich program and not limited to those objectives that one could expect almost all children to master prior to entering first grade.

One of the purposes of assessment is to note the progress a child is making towards mastering a set of objectives. The assessment will usually consist of both observations made while the child is working on a unit as well as a formal assessment at the end of a unit or units. Assessment at the kindergarten level differs from the procedures used at other grade levels in that the majority of the formal assessments are individually administered rather than group administered. The individual assessment is dictated not only by the fact the child cannot read and probably cannot write the numerals but also by the nature of the objectives themselves. For example, suppose the following objective is being assessed: Given three or more objects, order the objects on the attribute of length. The wording of the objective implies the child will be manipulating at least three lengths and not using a pictorial representation of the lengths, that is, the most appropriate way to assess the objective is to give the child at least three rods and ask the child to place them in order from shortest to longest. Some objectives are amenable to group test; for example,

objectives associated with the numerals such as identifying an orally given numeral or constructing a set to represent a numeral may be assessed in a group test as well as by an individually administered test.

The individually administered test may consist of one or two tasks per objective, each task requiring anywhere from 15 seconds to a couple of minutes to complete. Within a five minute period a child could be assessed on a variety of objectives. The advantage of the individually administered test is the opportunity to observe how the child approached a task and how the child solved it. For example, if the child were asked to order four strips from shortest to longest, one can note if the child ordered all four at the same time or if the child compared the strips in pairs, both responses are correct but an insight into how the child approached the task is obtained from observing the child at work. In addition to providing information on how the child approaches a task, whether or not the objective is mastered, children benefit from the individual attention of the teacher. Frequently more than mathematics is discussed during these assessment periods.

The formal assessment at the end of a unit provides valuable information on the child's progress. However, the day to day observations form the most important part of an assessment program. These daily observations provide an opportunity not only to note the progress a child is making towards mastering an objective but also hints as to additional activities the child may need. The observations can assist in forming groups for mathematics activities. The groups would not be the formal groups one frequently associates with grouping in the elementary school but rather loose arrangements of children for a single day or two.

It probably will not be possible for a teacher to observe each child every day during his/her mathematics activity but it will be possible for the teacher to note the progress that five or six children are making each day. A checklist with the objectives along with a place to note three or more observations for each objective would be helpful. Each time the teacher observed the child the teacher could write a short note or a single letter to indicate the progress a child is making. A child who has indicated mastery on a particular day might receive an M, a child who is making progress but who needs additional activities or opportunities could be noted with a P, and a child who appears to need special individual assistance might be indicated by an N or other letter. The child's progress also might be recorded by drawing diagonals or other lines in a square and then coloring the square when the child has demonstrated mastery of the objective. In this way a teacher may quickly see which children has been observed, the progress a child is making, and the type of activities the child needs. A child who appears to have mastered an objective on a given day may still need additional activities or activities of a more challenging nature relative to the same objective, may be ready to begin activities leading to mastery of yet another objective, or could be involved in activities of a more investigative nature. Thus we see that one of the major purposes of assessment is to assist the teacher in planning the most effective sequence of activities for each child. Just as we do not wish to involve a child in an activity for which the child is unprepared, that is, an activity whose prerequisites the child has not mastered, we do not wish the child to persist at tasks which the child views as busy work. The problem of mastering prerequisites is less of a concern in the kindergarten than at other grade levels but still remains an important consideration in selecting activities.

We have spoken of two broad categories of activities, those leading to mastery of an objective during kindergarten and those designed to provide the child with experiences with a concept but not necessarily leading to mastery of the concept upon the completion of the activities. Examples of mastery objectives which might be included in a kindergarten mathematics program are contained in Appendix II. The list in Appendix II is not meant to be an exhaustive list of objectives for a mathematics program nor is it meant to imply that each objective should be a part of a kindergarten mathematics program.

If one were to list the two most important attributes of an assessment program in mathematics at the kindergarten level one would include informal and individually administered. The outline contained in this section on assessment has included two components of an assessment program, daily observations and a formal assessment at the completion of a unit or units. The final judgment of a child's progress relative to the objectives would be a composite of both of these types of assessment procedures.

Dr. Wearne teaches in the Department of Curriculum and Instruction, College of Education, University of Kentucky.

Spatial Relationships and Young Children

Dr. Joseph A. Baust

"Jane, would you please look under the table next to the wall or my crayon and bring it to me?" This sentence communicates to young children quite an intricate group of directions that may ultimately help them to find an object in a chaotic environment. Thus, being able to know the position of someone or something in the adult word, being able to discriminate or even crudely measure where these things can be found, is where spatial words and mathematics play a crucial role.

Adults and teachers must recognize that the typical examples of spatial words, such as over, under, around, through, let children see things in relation to other things. "Johnny, go to the window and look below the windowsill for my pen;" relates quite a bit of information, but essentially tells the child where the pen can be found. Yet in this communication, children must have had positive experiences with spatial words in order that they may be successful at making orders, from a jangle of items, and from the mere stated words.

WORDS THAT RELATE SPACE

Children starting kindergarten may or may not have had experiences in the home with giving and taking directions. It would seem necessary that children be identified who have not had the opportunity to: (1) listen, (2) comprehend, (3) act out some direction, and provide such experiences in short but entertaining ways. Examples of funfilled activities may be:

(a) Get in the circle and act like a tiger.

(b) Go under that table (teacher pointing) and make a sound like a car.

(c) Pretend you are a merry-go-round and show how it would go around.

Even those children who have had such experiences need further reinforcement to provide a commonality of meanings.

It is most important that even initial experiences with directions containing spatial words not have too many subcomponents. The more to remember for the young child, the greater the chance for failure. The purpose of this exercise is to (1) provide simple experiences with taking directions, (2) provide a common ground for the understanding of simple spatial words, and (3) limit or eliminate opportunities for failure.

SPEAKING THE SAME LANGUAGE

A barrier to teaching spatial words stems from a child's confusion about words and their meanings. This is a result of (1) teacher experience differences, (2) loosely used terminology, (3) incorrectly used words, and (4) vague directions.

Teachers must be aware of possible differences between a child's conception of a spatial word and their own. Meaning differences may be due to a teacher's background and experiences; thus necessitating a careful look at the cultural and other uses of words used by the children versus the teacher's.

Often young children may express, act out a word based upon what they have heard/seen others do. "Go over to John's house," is markedly different from "Go over John's table," however, with a limited experience base a child may respond to either one of these phrases oppositely from what a teacher may intend.

Sometimes as a matter of convenience, laziness, adults will substitute a word in relating a spatial word. A phrase that is frequently abused is "Go over there." This incorporates a number of error patterns in relating spatial words. The word "over" is used and may be a source of a discrepency for the child while the word "there" might be anywhere creating quite a confusing predicament for the young child.

A commonly given direction to a child by a parent is, "It is in the drawer next to the window." This statement takes a great deal of imagination on the young person's part because many times the drawer may be beneath the window by a considerable distance, and may be one of several drawers in close proximity to the structure. Such a direction presents the child with a hard-to-interpret situation based on a vague direction. Later, the same parent may show the child, after the child has failed to retrieve an item they had asked for, the drawer they were speaking about, and may choose one not even remotely close to the window. This has reinforced two things for the child: (1) it is dificult and may be impossible to take directions and be successful; (2) what they think is, may be not what the child thinks by way of definition and usage.

WHAT ARE SOME SPATIAL WORDS

It is wise to classify spatial words according to how closely related they are to one another. Placing words meaning similar things with their opposites provides a common ground for a teacher to assist children in a positive manner.

An example of classifying by similar meanings and opposites are:

over - under

above - beneath (underneath)

on - off

on to - off

top - bottom

on top of - beneath/underneath

high - low

upside down----------rightside-up

inside----------outside

within----------without

in----------out

into----------out of

before----------after

in front of----------in back of (behind)

left----------right

Other words, while not being an exhaustive list of spatial words, may be classified to suit teacher need:

here	there
to	from
towards	away
near	far
closer	farther
close to	far from
back and forth	
next to	among
beside	through
alongside	side-ways
middle	inside-out
halfway	inside-out

Activities for spatial words should be started on a usage basis. Any words selected should be those most often used by the children in the individual classrooms. A small group of words may be selected to permit a simplistic and effective nucleus of words in which the children will grow to use orally.

Initial uses of opposites may not be wise because of the difficulty for some young children to see inverse operations. Therefore, confusion may be introduced if words such as over and under are simultaneously introduced. It is important that each child feel comfortable with each word without the burden of having to relate them at the very beginning.

GUIDELINES FOR TEACHING SPATIAL RELATIONS

After all of the preliminary steps have been taken, the teacher must then see that each child:

(1) sees the word in action,
(2) speaks the word with the action,
(3) has an opportunity to do what the word says and say the word,
(4) shares with other children.

A suggested implementation of a program using seeing, saying, doing, sharing might include a Spatial Day.

SPATIAL DAY

Teacher will select one word, i.e. under, have the word written on the board in big letters, or have it on a large mobile, or have the word on each desk. All of the children as they arrive will have to go "under" a string stretched out. The teacher could question the children about what they had to do to walk in the door of the classroom.

All other activities for the day would include the use of the word, i.e. under, and physical tasks associated with the term.

Suggested Sub-Activities for Spatial Day.

Language a. Teacher will have a story time and the children would sit "under a large table in the classroom."

1. Read a book to children that uses the word under. Have the children raise their hands every time the word is used.

Book Suggestions:

LUNO, Doris Herold. I Wonder What's Under, ill. by Janet McCoffery. Parents Magazine, 1970.

Physical Education

Activity I

Place a group of items, table chairs, and other such things in an obstacle course arrangement. Have the children go through the course. Everytime they go under something, they must say under.

The teacher may place the word "under" on the place where the child is to follow the direction.

It is most important that young children are physically active, creatively active, and speakingly active. Using such activities as the aforementioned will provide such opportunities so they can use spatial words effectively and without hesitation. This is what Sylvia Ashton Warner might allude to as on "Organic Vocabulary"--words of a spatial nature that children can comprehend because they know what they "feel like."

AVOID SPATIAL PITFALLS/MAKE POSITIVE IMPACTS

Spatial words are mathematical words. They teach position and order but attention must be paid to preventing failure pitfalls with these early skills.

Each word should be introduced through activities and not passivity. The young child should learn the spatial word through doing, not watching. This way the child will be far more capable of using words such as under with greater meaning.

Teachers must provide a positive model for using spatial words during the day. When speaking or giving directions to children, the teacher must be cognizant of the meaning intended and leave little doubt of this meaning through usage. Have children give directions and let the teacher

carry these out. The teacher's modeling is the most important part of providing an environment conducive to learning spatial words.

Much care must be taken to avoid words that are similar but have disparate meanings. This may be because of teacher experience or the child's experience. Nonetheless, care must be taken to assure a commonality of meaning in all spatial word communications.

With the understanding of the intricacies of spatial words, the methods in which teachers must address themselves, children will have positive initial experiences within a most important mathematical area.

Dr. Joseph Baust is an assistant professor in the Department of Instruction and Learning, Murray State University.

A Rationale for Teaching Measurement and Graphing

Ellen Schlafer and Renee Prillaman Coates

Very often the basic math skills in kindergarten include only numeral and set recognition. A vast amount of concepts are untaught, unavailable, and unknown to the kindergarten child. Although they are a part of his/her every day life, prenumber skills, geometry, fractions, time, money, measurement and graphing (yes, graphing) are often completely ignored.

Measurement skills should be viewed as an integral part of the kindergarten curriculum. It is natural for measurement activities to be included since it is an area young children are already exploring. The observant teacher will note children comparing lengths, volumes, and masses of objects. Tremendous amounts of experimenting go on in areas such as sand and water or blocks. A well-rounded curriculum should capitalize on the child's interest in this area. In addition, measurement is a practical life activity that children will use every day.

The kinds of activities used to teach measurement are of the utmost importance. The developmental needs of the children dictate the use of concrete objects. One would not begin measurement skills instruction with a workbook page and a ruler, but rather with non-standard units of measure such as body parts. Concrete objects are very important even after this phase and the teacher can use blocks, Cuisenaire rods, or wooden cubes as "beginning rulers." It is only after many experiences with concrete objects that the child can begin to actually measure as we understand measurement.

Measurement lends itself well to the discovery method and can best be approached through individual and small group activities in centers. The

teacher's major role is to create an environment conducive to exploration and to provide reinforcement and extension as needed.

Unlike measurement activities, graphing is more effective in the large group setting. Piaget advocates activity for young children that includes interaction with the environment and concrete materials. Graphing puts his theory into practice since it is merely a concrete method of recording what children classify. In graphing, the child will count, compare sets and develop the concepts of "greater than" and "less than." A graph then gives the child a visual image of the "greater than-less than" relationships among sets. At this point, interaction between teacher and student is crucial.

The teacher must provide the children with concrete objects before attempting to graph with pictures and symbols. Any common objects may be classified and placed upon a large grid. It is only then that the children will be prepared to comprehend a standard bar graph. Because the child is actively involved in a process which results in an appealing product, graphing is a rewarding and positive experience.

Renee Prillaman Coates is a kindergarten teacher at Wellington Elementary in Jefferson County.

Ellen Schlafer is a kindergarten teacher at Okolona Elementary, Jefferson County.

The Interplay of Math Activities and Pre-reading Skill Development

Kay Wright

While mathematics activities have been isolated for the purpose of this publication, this does not indicate that math activities provide for skill development in the area of mathematics alone. A simple game of counting objects into a container provides not only for skill development relative to counting concepts, but also for eye-hand coordination and small muscle development. Likewise, using temperatures of liquids as a lesson in ordering provides an excellent science experiment opportunity.

Stongly interrelated is the development of language concepts and math activities. The recent (1979) Learning to "Read My World: Language Experiences for Young Children publication of the Kentucky Department of Education lists several areas of language experiences which effectively utilize concrete math activities.

1. "The Child and the Environment: Active Interaction: which includes:

   . . .classification, ordering and matching materials

   . . .patterning

   . . .shape discrimination

   . . .experience with position, lines and curves

   . . .counting and numeral recognition

   . . .measurement

   . . .graphing

   . . .time and money

   Actual concrete experiences in math related areas such as those mentioned provide not only for the intended math skill development, but also a foundation of knowledge which can be described or transmitted through a, now meaningful, language process.

2. "Using Language: Speaking and Listening"

Children must acquire language communication tools before they can transmit acquired math information to other individuals. Not only can they orally communicate information about concepts, but they can extend their understanding of math concepts through the listening mode. Many children's books strengthen math concepts while increasing the child's listening skills. (Directions given with activities also help strengthen listening skills.) The following list contains some suggested books for the kindergarten classroom.

Alain, One, Two, Three, Going to Sea. New York: Young Scott Books, 1964.
Anno, Hitsumasa. Anno's Counting Book. New York: Crowell, 1977.
Berkley, Ethel. Big and Little, Up and Down. Reading, Mass: Addison-Wesley, 1950.
Borton, Helen. Do You See What I See? New York: Abelard-Schuman, 1959.
Buckley, Helen. The Little Boy and the Birthday. New York: Lothrop, Lee and Shepard, 1965.
Carle, Eric. 1, 2, 3 to the Zoo. Cleveland: The World Publishing Company, 1968.
Elkin, Benjamin. Six Foolish Fisherman. Chicago: Childrens Press, 1957.
Francoise. Jeanne-Marie Counts Her Sheep. New York: Charles Schribner's Sons, 1963.
Francoise. What Time Is It, Jeanne-Marie? Charles Scribner's Sons, 1963.
Frisky, Margaret. Chicken Little, Count-To-Ten. New York: Childrens Press, 1946.
Hoban, Tana. Count and See. New York: Macmillan, 1972.
Krauss, Ruth. The Birthday Party. New York: Harper and Row, 1957.
Langstaff, John. Over in the Meadow. New York: Harcourt, Brace, Jovanovich, (paper) 1973.
Leonni, Leo. Inch by Inch. New York: Astor-Honor, 1962.
Sendak, Maurice. One Was Johnny: A Counting Book. New York: Harper, 1962.
Slobodkin, Louis. Millions, Millions, Millions. New York: McGraw-Hill, Inc., 1966.
Wildsmith, Brian. Brian Wildsmith's 1, 2, 3's. New York: Franklin-Watts, 1965.
Zolotow, Charlotte. One Step Two. New York: Lothrop, Lee and Shephard, 1955.
Zolotow, Charlotte. Over and Over. New York: Harper and Row, 1957.

3. "Functional Language Using Print."

   An additional factor in learning to read is learning to "use" language. Perhaps the most effective way of stressing this concept in the math realm is the use of direction or "recipe" charts. Cooking recipes list necessary amounts of ingredients to be used -- an excellent measuring and fraction learning activity. Pictoral representations can be used to increase the understanding of printed material.

   Directions for learning center math games can be printed on charts with reinforcing pictoral representations.

4. "Speech to Print What I Say Can Be Written"

   Just as dictated stories reinforce the speech to print concepts, so do dictated descriptors. Labeling objects as "5 birds" or "2 green frogs" serves to reinforce both speech to print and counting concepts. Graphing experiences where labeling occurs are also valuable in representing the speech to print concept.

Concluding, concrete math activities should be considered not only for their value in developing mathematics skills, but also for their value in strengthening concepts in other content areas as well as increasing perceptual motor skills and increasing verbal self-expression. Of significant importance is the interplay of math and language growth -- a factor to be considered in curriculum planning.

Kay Wright Springate is an Early Childhood Educator in the Department of Home Economics at Eastern Kentucky University.

A SEQUENTIAL LISTING

OF APPROPRIATE MATHEMATICS SKILLS

FOR YOUNG CHILDREN

A Sequential Listing of Appropriate Mathematics Skills for Young Children

The following is a list of mathematics skills classified by area and arranged according to developmental considerations. The listing should be helpful in planning and assessing mathematics activities in daily curriculum plans.

I. Pre-number

A. Sorting (classification)

1. One characteristic
2. Two characteristics
3. Three characteristics

B. Ordering

1. Size
2. Weight
3. Temperature
4. Shades of color

C. Matching (1 to 1) color, etc.

D. Patterns

1. Copy
2. Extend
3. Create

II. Geometry

A. Shape discrimination
Triangle, rectangle, square, circle, crescent, star, cross, oval and diamond.

B. Spatial relations
Inside, outside, over, under, above, below, next to, in front of, behind, up, down, top, bottom, right, left, the side of, edge, corner, etc.

C. Lines and curves

1. Open and closed
2. Types of lines - straight, curvey, wavy, zig-zag, etc.

D. Three dimensional shapes
Towers, cubes, blocks, cones, cylinders, spheres, and arches.

III. Number

A. Cardinal number
   1. Reproduces sets of 1-5 concrete objects -- then zero (0) concrete objects
   2. Reproduces sets of 6-9 concrete objects
   3. Attaches oral names to sets
   4. Attaches numerals to sets
   5. Counts and orders sets

B. Ordinal numbers
   1st through 5th

IV. Measurement (Linear, volume, weight)

A. Arbitrary units

B. Simple measuring tools

C. Standard units - metric and English

V. Graphing (Bar graphs)

A. Concrete objects

B. Pictures

VI. Time and money

A. Time reference points - lunchtime, day and night, Christmas, birthdays, etc.

B. Clocks - hours, past the hour, minutes

C. Calendars -- days, weeks, months, years

D. Coin recognition - penny, nickel, dime and quarter

E. Values of penny, nickel, dime and quarter

VII. Fractions

A. Whole and half of objects

B. Whole and half of pictures

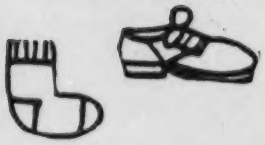
VIII. Operations

A. Same amount -- greater than and less than

B. Combining sets

C. Separating sets

**The activities which follow are arranged according to the above skills listing.



MATHEMATICS

ACTIVITIES

ACTIVITIES

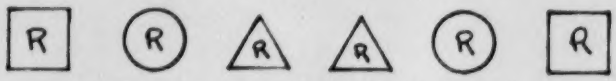
I. Pre-number.

A. Sorting (classification)

1. ACTIVITY: Classifying Blocks.

SKILL: Picking an attribute which is common to all blocks.

MATERIALS NEEDED: Assorted red blocks.



PROCEDURE: Ask the children to classify the above blocks. "They are all red".

SUGGESTED FOLLOW-UP: Do the above with yellow blocks, blue blocks, and other objects in the room all have the same color.

2. ACTIVITY: Classifying Blocks.

SKILL: Classifying objects according to one attribute.

MATERIALS NEEDED: circles, squares, and triangles in two sizes, each size in two colors.

PROCEDURE: Place the blocks on a table, at random. Ask children to group them so each group is alike in some way.

Ask children if they can group the blocks another way.

SUGGESTED FOLLOW-UP: Ask children to bring "things" in from the playground and group these objects so each group is alike in some way.

3. ACTIVITY: Classifying emergency vehicles.

SKILL: Classifying objects by matching them to the place where they belong.

MATERIALS NEEDED: Toy police cars, wreckers, ambulances, and fire engines.

Boxes are designed as hospitals, police stations, garages, and fire houses.

PROCEDURE: Set up the buildings and have the children put each toy emergency vehicle in the vicinity of the building where it belongs.

SUGGESTED FOLLOW-UP: Use furniture and part of house where each piece belongs; use sporting equipment and sport in which it would be used, etc.

4. ACTIVITY: Classifying bottle caps

SKILL: Classify bottle caps by the type of lines each cap contains (plastic, cork, etc.)

MATERIALS NEEDED: Many bottle caps of kinds of soft drinks.

PROCEDURE: Place caps into sorting trays which are labeled plastic, cork, etc.

SUGGESTED FOLLOW-UP: Classify caps according to kind: coke, pepsi, etc. Classify nuts according to shape, size color, etc. Classify stones by their size, color, shape, etc.

5. ACTIVITY: Determining whether objects will float.

SKILL: Classify objects according to their floating or sinking ability.

MATERIALS NEEDED: Large pan of water, several items that will float, balloons, corks, styrofoam objects, wood, etc. Several items are heavy and will sink: rocks, ball bearings, marbles, etc.

PROCEDURE: Ask children which objects will float and then let them classify objects as to whether they sink or float by actually placing them in the pan of water.

6. ACTIVITY: Classify objects as to whether or not magnet will pick up.

SKILL: Determining if objects are attracted to a magnet.

MATERIALS NEEDED: Large collection of articles which can be attracted to magnet; coins, nails, paperclips, etc. Large collection of articles containing no metal: paper, wooden blocks, plastic toys, buttons, etc.

PROCEDURE: Ask children which articles will be attracted by magnet, then let them find out for themselves by using the magnet and then by classifying objects as to whether or not they were attracted by magnet.

SUGGESTED FOLLOW-UP: Graph the objects by gluing them on construction paper.

7. ACTIVITY: Classify nails.

SKILL: Classify nails as to size.

MATERIALS NEEDED: Divided sorting tray, many nails of all sizes and kinds.

PROCEDURE: Have children sort the nails by putting all nails of same size in a particular section of the tray.

SUGGESTED FOLLOW-UP: Classify nails as to kind: finish nails, roofing nails, etc.

8. ACTIVITY: Classify buttons.

SKILL: Classifying buttons as to color.

MATERIALS NEEDED: Lots of buttons of several different colors, sizes, and different number of holes.

PROCEDURE: Label egg carton holes with difference colors and have children place buttons in proper hole.

SUGGESTED FOLLOW-UP: Classify buttons as to size and classify buttons as to number of holes.

Classify buttons using 2 attributes 1-1. Large white buttons in one container and those which are not both large and white in another.

9. ACTIVITY: Classifying shapes.

SKILL: Sorting as to size and shape.

MATERIALS NEEDED: Lots of plastic or wooden attribute blocks or circle, squares, triangles, rectangles cut out of construction paper; sorting trays each labeled with a large or small circle, square, triangle, or rectangle.

PROCEDURE: Have children take turns at placing a block in the correct sorting tray.

SUGGESTED FOLLOW-UP: Classify the blocks according to shape and color or size and color.

10. ACTIVITY: Sorting according to length.

SKILL: Finding sticks of equal length.

MATERIALS NEEDED: Several sticks of assorted lengths. One stick to be used as measuring stick, several sticks of this same length, several which are much shorter and several which are much longer.

PROCEDURE: Give the child the measuring stick and ask the child to pick out all the sticks which are the same length as this one.

11. ACTIVITY: Sorting transportation vehicles by type.

SKILL: Classifying transportation vehicles as to whether they travel on land, sea, or air.

MATERIALS NEEDED: Several toy scooters, bicycles, trucks, cars, train engines, airplanes, balloons, sailboats, ships, canoes, etc.

PROCEDURE: Label sorting trays with pictures of land, sea, and sky. Have children place the toy vehicles in the tray on which that vehicle travels.

SUGGESTED FOLLOW-UP: 1) Sort pictures of sailors, airmen, and infantryman the same way.

2) Sort birds, turtles, rabbits, fish, etc. using trays labeled land, sea, air.

12. ACTIVITY: Going shopping.

SKILL: Sorting (classification)

MATERIALS NEEDED: 3 shoe boxes decorated as stores (grocery, clothing, toy). Pictures of toys, food and clothing mounted on poster board.

PROCEDURE: Have the children place the pictures in the appropriate box.

SUGGESTED FOLLOW-UP: Each class may be divided; toys with wheels - toys without wheels -men's clothing - women's clothing - food we chew - food we drink.

B. Ordering

1. ACTIVITY: Order stones from big to little.

SKILL: Determining relative to size.

MATERIALS NEEDED: Have children collect many stones (all different sizes) from the playground.

PROCEDURE: Select 5-6 stones of varying sizes and have child order them from largest to smallest.

Increase the number of stones to be ordered as children become proficient.

SUGGESTED FOLLOW-UP: Order objects from pockets and purses.

2. ACTIVITY: Order nesting boxes.

SKILL: Order by size.

MATERIALS NEEDED: Several boxes of different sizes which will fit one inside another until all are nested.

PROCEDURE: Have child "nest" the boxes by starting with the largest and inserting next to largest and then next to largest and then -- on down to smallest.

SUGGESTED FOLLOW-UP: Use cooking untensils for above "nesting". Also V-8 cans.

3. ACTIVITY: Ordering straws by length.

SKILL: Ordering from largest to smallest and smallest to largest.

MATERIALS NEEDED: Several drinking straws cut into different lengths.

Toilet paper tubes, paper towel tubes, broom handles, etc. could be used.

PROCEDURE: Give child 3 or 4 pieces of straw of different length and have them order the straws from longest to shortest and then from shortest to longest.

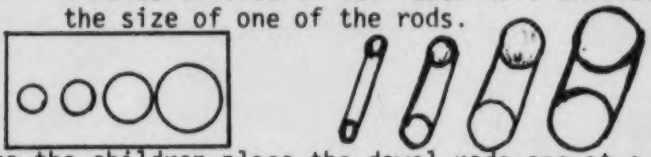
SUGGESTED FOLLOW-UP: 1) Increase the number of straws to be ordered as the children gain in skill.

2) You order straws and have children tell what order you used.

4. ACTIVITY: Order dowel rods in holes in board.

SKILL: Ordering dowel pins by fitting them into proper holes.

MATERIALS NEEDED: 4 different sized dowel pins (approximately 4" - 6" long), a 6" piece of 2" x 4" with 4 holes drilled in it. Each hole drilled the size of one of the rods.



PROCEDURE: Have the children place the dowel rods one at a time in the hole in which it best fits.

5. ACTIVITY: Ordering paint chips.

SKILL: Recognizing degree of color.

MATERIALS NEEDED: White paint chips, very light grey chips, medium grey, dark grey, and black chips.

PROCEDURE: Ask a child to order the 5 chips (one of each shade) from light to dark.

Ask child to order chips from dark to light.

SUGGESTED FOLLOW-UP: Ordering foods by temperature of food.

SKILL: Determining which foods are coldest.

MATERIALS NEEDED: Pictures of foods such as ice cream, milk, when foods are ready to eat.

SUGGESTED FOLLOW-UP: Above activity may be preceded with a tasting session.

7. ACTIVITY: Ordering objects by weight.

SKILL: Ordering familiar objects from lightest to heaviest, determining relative weights.

MATERIALS NEEDED: Several available objects such as baseball, bat, paper clips, pencil, chalk board, eraser, dictionary, etc.

PROCEDURE: Have child order objects, after lifting each, from lightest to heaviest.

8. ACTIVITY: Vegetable sizes.

SKILL: Ordering sizes, sorting.

MATERIALS NEEDED: Vegetables of different sizes - potatoes, squash cucumbers, green beans, carrots.

PROCEDURE: At a learning center, have the child order the vegetables from smallest to largest.

SUGGESTED FOLLOW-UP: Have the child find different vegetables that are the same length or have the same mass (use a balance).

C. Matching (1 to 1 patterns)

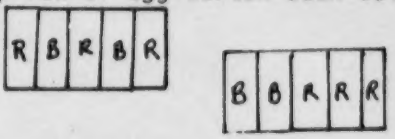
1. ACTIVITY: Forming a pattern.

SKILL: Recognizing a pattern and putting objects in one-to-one correspondence.

MATERIALS NEEDED: Egg carton, large red beads, large blue beads, small red beads, small beads.

PROCEDURE: Arrange beads in top row of egg carton such as:

Bottom row like:

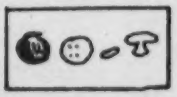


Ask child to rearrange bottom row to match top row.

2. ACTIVITY: Make a pattern.

SKILL: Copy pattern, extend pattern.

MATERIALS NEEDED: Macaroni, beans, shells, buttons - glue one of each on a long strip of poster board.



PROCEDURE: Have the child copy the pattern underneath each object. Extending the pattern can be accomplished only after many experiences with copying.

SUGGESTED FOLLOW-UP: Make patterns with children. Have them stand, sit, stand, sit, stand, sit, etc.

3. ACTIVITY: Copying a pattern.

SKILL: Seeing, copying and forming patterns.

MATERIALS NEEDED: Several coins.

PROCEDURE: Place a nickel, a dime and a quarter in that order. Give the child some coins and ask the child to copy the pattern. Ask child to reverse the order of the pattern.

SUGGESTED FOLLOW-UP: Place 2 pennies, 2 dimes and 1 quarter in a row. Ask child to copy patterns. Ask child to reverse order of pattern.

4. ACTIVITY: Copying a pattern.

SKILL: Seeing, copying and forming patterns.

MATERIALS NEEDED: String several different beads.

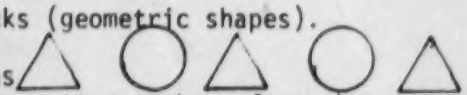
PROCEDURE: String beads (start with 5 or 6) of different colors, picked at random and ask child to copy pattern by stringing beads on child's stringer.

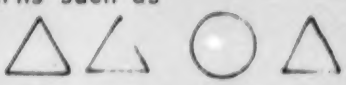
SUGGESTED FOLLOW-UP: Increase number of beads as child's skill increases.

5. ACTIVITY: Copying pattern.

SKILL: Seeing, copying and forming patterns.

MATERIALS NEEDED: Attribute blocks (geometric shapes).

PROCEDURE: Form a pattern such as  Ask child to copy your pattern, then after these 5 blocks are copied, ask "What comes next?" Ask child to continue with this pattern.

SUGGESTED FOLLOW-UP: Use more complicated patterns such as  with above activities.

6. ACTIVITY: Forming a pattern with children.

SKILL: Recognizing and continuing a pattern.

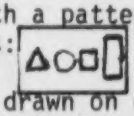
MATERIALS NEEDED: The boys and girls in your classroom.

PROCEDURE: Ask 2 girls to stand 1 behind the other, then 2 boys to stand 1 behind the 2nd girl the other behind the 1st boy, then 2 more girls, then 2 more boys. Ask a child to line up the rest of the class following the established pattern.

SUGGESTED FOLLOW-UP: Vary the pattern.

7. ACTIVITY: Copy patterns.

SKILL: Seeing, copying and forming patterns.

MATERIALS NEEDED: (1) attribute blocks (geometric shapes) or shapes cut out of cardboard; (2) General envelopes each with a pattern drawn on the envelopes, such as: 

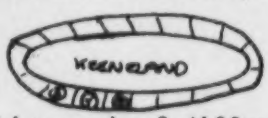
PROCEDURE: Place 3 of the 4 shapes, drawn on envelope, in the envelope and ask child to form the pattern. Ask "What is missing?"

SUGGESTED FOLLOW-UP: Place 4 shapes in envelope with one of the shapes being incorrect (not fitting pattern). Ask child to form pattern on envelope.

8. ACTIVITY: Copying and continuing a pattern.

SKILL: Recognizing, copying and forming a pattern.

MATERIALS NEEDED: Several colored chips and a race track:



PROCEDURE: Place 3 chips each of different color on the race track and ask child to continue this pattern on around the track.

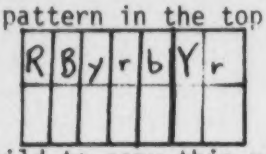
SUGGESTED FOLLOW-UP: Vary the pattern, such as: red, yellow, yellow, blue, or use 4 colors, etc.

9. ACTIVITY: Copying a pattern.

SKILL: Classifying and ordering objects while copying a pattern.

MATERIALS NEEDED: Egg cartons, several small buttons of 2 or 3 different colors and several large buttons of 2 or 3 different colors.

PROCEDURE: Form a pattern in the top row of egg carton such as:



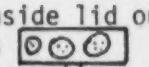
Ask child to copy this pattern in lower row of of egg carton.

SUGGESTED FOLLOW-UP: Ask child to reverse the pattern.

10. ACTIVITY: Copying a pattern.

SKILL: Classifying and ordering objects while copying a pattern.

MATERIALS NEEDED: Egg cartons and several white buttons, some large with 2 holes, some large with 4 holes, some small with 2 holes, some small with 4 holes.

PROCEDURE: Inside lid on a piece of paper draw a pattern such as  . Ask child to copy the pattern in top row and reverse the pattern in the bottom row of egg carton.

SUGGESTED FOLLOW-UP: Ask children to form a pattern in top row for a neighbor to copy in bottom row.

11. ACTIVITY: Arrange people pictures from youngest to oldest.

SKILL: Forming a pattern.

MATERIALS NEEDED: Pictures of all different ages: baby, young child learning to walk, child playing, el. sch. age child, high sch-age, young adult, middle age and old age.

PROCEDURE: Have children arrange pictures in age sequence, from youngest to oldest.

SUGGESTED FOLLOW-UP: Arrange activity pictures by age of participants from youngest to oldest.

II. Geometry

A. Shape Discrimination

1. ACTIVITY: Separating cookies (Housekeeping Center).

SKILL: Shape discrimination

MATERIALS NEEDED: Nine "cookie jars" labeled with a triangle rectangle, square, circle, crescent, star, cross, oval and diamond.

Variety of "cookies" (baked clay) of same shapes.

PROCEDURE: Ask the children to separate and classify "cookies" in the appropriate cookie jars.

SUGGESTED FOLLOW-UP: Have children bake cookies using the same shape.

2. ACTIVITY: Walk-a-Shape.

SKILL: Recognizing shapes.

MATERIALS NEEDED: Blindfold and attribute blocks.

PROCEDURE: Ask children to create a certain shape with their bodies. Ask one child to walk around the shape. Blindfold the child and ask him/her to feel attribute blocks to find the same shape.

3. ACTIVITY: Producing and copying shapes.

SKILL: Shape discrimination

MATERIALS NEEDED: Attribute blocks, paper, pens, yarn and paste.

PROCEDURE: Ask each child to create his/her own picture using the attribute blocks. The children exchange pictures and reproduce the design received by gluing yarn on toyp.

SUGGESTED FOLLOW-UP: Have the designs on the wall and use a tracing activity.

4. ACTIVITY: Face painting.

SKILL: Shape discrimination.

MATERIALS NEEDED: Grease pens or water crayons, sponges cut into one shape each of a triangle, rectangle, square, circle, crescent, star, cross, oval and diamond, mirror.

PROCEDURE: Have the children decorate each other's faces with pens using only one shape per face (example: triangles, circles, etc.). Each child then guesses what shape is on his/her face. Using the mirror (s)he then uses the corresponding shaped sponge to wash his/her face.

* Sponges can be placed in the water table.

B. Spatial Relations

1. ACTIVITY: What's the hoopla.

SKILL: Spatial relations.

MATERIALS NEEDED: Hula-hoop/one per child.

PROCEDURE: Each child needs a hula-hoop to try these individual activities. 1) Find a hoop and sit INSIDE it; 2) Jump INTO the hoop. Jump OUT; 3) Check to see that each of these tasks is accomplished. 4) Move AROUND INSIDE the hoop without using your feet; 5) Skip AROUND the hoop; 6) Pick UP the hoop without using hands. Put it ON the floor; 7) Put the hoop BEHIND you; put it against the BACK of your legs; now turn slowly AROUND until the hoop is IN FRONT of you; 8) Choose partner. Both sit INSIDE one hoop; 9) Hold the hoop ABOVE your partner; 10) Hold one hoop so your partner can crawl THROUGH it; UNDER it; 11) place two hoops on the floor and walk BETWEEN the hoops.

This activity would be introduced gradually: a few steps at a time. This can also be used as an obstacle course. There would be various physical activities which you could use the hula-hoop in the classroom.

2. ACTIVITY: Leap and crawl.

SKILL: Spatial relations.

MATERIALS NEEDED: Gym/Out-of-doors.

PROCEDURE: Get the children in line. Then have the first person squat with his or her head down. The next person jumps OVER the one squatting and he/she stands with his/her legs way apart for someone to crawl UNDER. This continues until everybody has crawled and leaped. When a child goes under, the

whole class says, "UNDER" and when a child goes over, the whole class says, "OVER."

3. ACTIVITY: Pass the ball.

   SKILL: Spatial relations.

   MATERIALS NEEDED: One ball.

   PROCEDURE: Have children in large circle with teacher in center; could also be small group activity. Encourage creativity. EXAMPLE: Sam, the first player says, "Sam passed the ball OVER his head to me, and I am passing the ball to John UNDER my left arm." John says, "Jim passed the ball to me UNDER his left arm, and I am passing the ball to Mary BEHIND my back." Mary says, "John passed the ball . . ."

4. ACTIVITY: Pantomine.

   SKILL: Spatial relations.

   MATERIALS NEEDED: Students, chalkboard, chalk.

   PROCEDURE: Children are placed in the circle and told to act out, without speaking, the movements that the teacher calls out. Example: "Say with your eyes, "UP." When students have been given several examples, one player may be chosen to act-out words which will involve discussion of spatial relationships, much like charades. If the word is airplane, the audience might ask questions using words written on the board, such as: "Is is large or small?" "Do you see it in school or outside?" "Will it go through a door?" "Can I put my arms around it?" The player will answer all questions by nodding his head or gesturing with his arms until students in the audience have discovered the secret word.

5. ACTIVITY: Popple people.

   SKILL: Spatial relations.

   MATERIALS NEEDED: Two old magazines, several popsicle sticks, glue per student.

   PROCEDURE: Have the students make stick puppets by gluing a picture on the end of a popsicle stick. Make sure they write their names on the sticks. Have the students stand up, holding their "Popple People." Give comments and have the classmates

follow, such as: 1) Put your Popple People OVER your head; 2) Put your Popple People ON TOP of your shoe; 3) Put your Popple People in your LEFT HAND, in your RIGHT HAND; 4) Place your Popple People UNDER your arm; 5) Pass your Popple People AROUND your body; 6) Trade Popple People with someone BESIDE you; 7) Trade People with someone IN FRONT of you; 8) Put the People BETWEEN your fingers; 9) Hold your People HIGH: Hold then LOW; 10) Gently place the People BENEATH your shoe; 11) Hide the People BEHIND your back; 12) Get your own Popple People from your classmate. Put your People INSIDE your desk; 13) Place your body ON your chair.

6. ACTIVITY: Getting your goat.

   SKILL: Spatial relations.

   MATERIALS NEEDED: One table, chairs, rocks. The furniture should be arranged for the performance. The arrangement is as follows: one table (used as the bridge), chairs at different height levels (used as hills), and rocks around the table legs (used as rocks in the river).

   PROCEDURE: Read the story, "The Three Billy Goats Gruff," to to the entire class; the children will perform the story taking on the roles of the story characters. After the teacher reads the story, then (s)he (teacher) will have the children retell the story in sequence. Now it will be time to role play in the classroom. Arrange furniture as mentioned above. Characters: troll, three goats--Big Billy Goat Gruff, Medium Billy Goat Gruff, and Little Billy Goat Gruff. The troll sits UNDER the table. The goats come DOWN the hill and OVER the bridge UP to the other hill on the other side. The troll comes OUT from UNDER the bridge and UP on top of the bridge and lands IN the river.

7. ACTIVITY: Space Commander May I.

   SKILL: Spatial relations.

   MATERIALS NEEDED: Geometric figures, i.e. circles, triangles, squares, rectangles, semi-circles.

   PROCEDURE: To begin the game, players line up at the starting point. The space commander calls upon a player and tells the player to perform a task dealing with

spatial terms. For example, "Mary walk around the circle." The player must say, "Space Commander, "may I walk around the circle?" If a player fails to do the stated tasks (s)he must return to the starting point. The first player to work his way up to the space commander and touch him gets to be space commander.

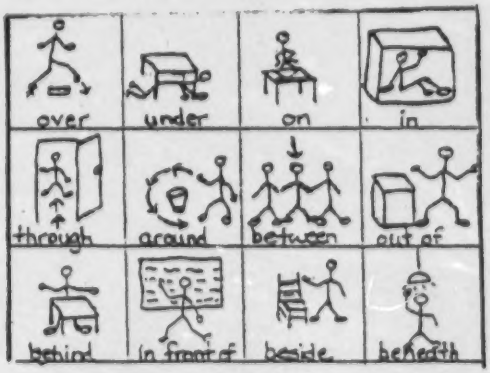
SUGGESTED FOLLOW UP-UP: Tasks may be varied according to each child's sophistication, i.e. his/her ability to remember a sequence of directions.

8. ACTIVITY: Bean bag toss.

SKILL: Spatial relations.

MATERIALS NEEDED: *Game mat pictured below, several bean bags. *Prepare a game mat similar to the one below on a large sheet of plain white oil cloth. The squares can be illustrated simply with colored marking pens or elaborately by gluing-on felt cut outs.

PROCEDURE: Lay the mat on the floor. Place a strip of masking tape one meter from the bottom edge of the mat to indicate to the students where they are to stand. Students take turns tossing a bean bag onto the mat and duplicating the activity shown in the square in which their bean bag lands or demonstrating a new activity which will relate the meaning of the spatial term in the square. At the same time (s)he does the activity, the student verbalizes in sentence form what (s)he is doing. The game continues until all the students have participated.



9. ACTIVITY: Simon Says

SKILL: Spatial relations.

MATERIALS NEEDED: Students.

PROCEDURE: Using the same terms and directions from "Simon Says," implement the use of the terms above, around, over, through, between, and inside. Pick children at

random to complete tasks involved with these terms. The teacher uses Simon Says in some sentences and leaves Simon Says out of other sentences. Give one point for each time the children respond correctly to the term and to their responding to Simon Says. The first child to reach 10 points wins the game.

C. Lines and Curves

1. ACTIVITY: Clay curves.

   SKILL: Identifying open and closed curves and types of lines.

   MATERIALS NEEDED: Clay.

   PROCEDURE: Have the children roll a piece of clay "snake fashion." Then each child forms his/her own curve or line and asks a neighbor to describe his/her line or curve.

2. ACTIVITY: Movement with hoops.

   SKILL: Positional terms and closed curves.

   MATERIALS NEEDED: Hula Hoop or jump ropes formed into a closed curve.

   PROCEDURE: Designate a child as the "caller". Other children place their hoop or rope in front of them. As the "caller" calls different positional terms the children move to that position in relation to a hoop or rope.

D. Three dimensional shapes

1. ACTIVITY: Duplicating structures.

   SKILL: Three dimensional shapes.

   MATERIALS NEEDED: Unit blocks.

   PROCEDURE: The teacher creates a structure in the block center. The children are then asked to copy line structure. Children can then create models.

2. ACTIVITY: Junk sculptures.

   SKILL: Three dimensional shapes.

   MATERIALS NEEDED: Large collection of "junk" which includes cubes, cones, cylinders, spheres, and arches; paste and paint.

PROCEDURE: Ask the children to select objects from the junk to form one or two shapes. The child can create and paint his/her sculpture.

III. Number.

A. Cardinal number.

1. ACTIVITY: Dot pattern match.

SKILL: Reproduces sets of 1-5 concrete objects-then 0 concrete objects.

MATERIALS NEEDED: Ten counters. Paper plates (or posterboard cut to the size of paper plates). Each plate has a set of 0-5 large dots drawn on it. There should be several plates having 4 dots and several having 5 dots; various patterns should be used. (e.g. ⁘ , ⁙).

PROCEDURE: A child selects a dot plate at random and then a set of counters which he/she thinks will exactly match the dots on the plate. Then he/she checks his/her selection by placing the counters, one at a time, directly on the dots.

SUGGESTED FOLLOW-UP: One child shows a dot plate for an instant to a second child. The second child then holds up as many fingers as he/she thinks were dots on the plate shown. The second child checks by placing his fingers directly on the dots.

2. ACTIVITY: Make it and check it.

SKILL: Reproduces sets of 6-10 concrete objects.

MATERIALS NEEDED: Pieces of posterboard-each with a set of 6-10 pictures pasted upon it. The pictures on each piece of posterboard are alike-e.g. 6 glasses, 7 people, 8 cups, 9 shoes, 10 baseball bats twelve to fiften straws, plates, plastic spoons, socks and baseballs. The pictures can be arranged in the familiar domino patterns, if desired.

PROCEDURE: The child selects a piece of posterboard and then decides how many objects are needed to match (1 for 1) the pictures on the posterboard. For example, the child decides how many straws must be taken so that each of the (6) glasses will have

exactly one straw. When the child thinks (s)he has the correct number of objects he checks by matching the objects with the pictures on the posterboard.

SUGGESTED FOLLOW-UP: Make a set of dot plates, each with a set of 6-10 dots drawn on it. Have the child match each dot plate with the picture set (described above) having the same number of pictures. Counters placed on a dot place can be transferred to a set of pictures to determine if the dot set and the set of pictures match.

3. ACTIVITY: Eggs in a basket.

SKILL: Attaches oral names to sets.

MATERIALS NEEDED: An egg carton with the last two egg cups removed, and "pretend eggs." Any objects that fill the egg cups may be used for eggs.

PROCEDURE: The teacher holds up one egg and says, "This is one egg." Then (s)he places it in the egg carton like this

and has the children do the same. (S)he says, How many eggs do you have in your carton?" Then (s)he takes another egg and says, "I have one more egg." (S)he puts it in the carton like this,

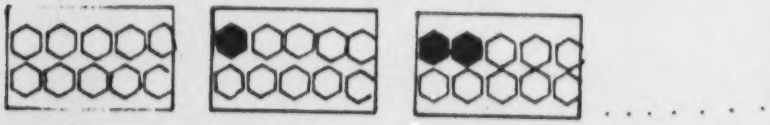
and says, "Now I have two eggs in my carton. Would each of you put one more egg in your carton just like I did, beside the other egg. How many eggs do you have in your carton? This procedure is continued until all ten eggs have been placed in the carton. Each number is created by adding "one more egg" to the previous number of eggs. The eggs are placed in the carton so that the top row fills-up completely and then the bottom row fills-up, proceeding from left to right like the top row. The most important concept to develop it that each number is one more than the proceeding number. Thus, the teacher should often make statements like, "six eggs and one more egg-that makes seven eggs." This development of the oral number names will require several lessons. After a child constructs a set of eight eggs, for example, (s)he should also contruct other sets of eight objects. In particular, (s)he should learn to hold up eight fingers.

SUGGESTED FOLLOW-UP: Help children attach oral number names to sets that they are familiar with-like the dot plates in the activity "Dot Pattern Match" and the picture sets in "Match It and Check it." One strategy for making the attachments is to have children find sets which match, 1 for 1, with a set of fingers for which they have already learned the oral number name.

4. ACTIVITY: Matching egg with numerals.

SKILL: Attaches numerals to sets, 0-10.

MATERIALS NEEDED: Stylized drawings of egg cartons, (See the activity, "Eggs in a Basket") partially filled with eggs as shown here:



Cards with a numeral, 0-10, on each one.

PROCEDURE: The egg carton drawings are arranged randomly in front of a small group of children. The teacher asks the children to find, in order, the drawings showing "zero" through "ten" eggs. After each drawing is found the teacher places the correct numeral card to match the drawing. As this matching practice is repeated the teacher asks the children to find the drawings showing "one more than six eggs, one less than three eggs," etc.

SUGGESTED FOLLOW-UP: (1) one child uses a set of numeral cards (0-10) as another child holds up one of the egg carton drawings. The first child chooses the numeral card which tells how many eggs were shown on the drawing held up by the second child. (2) One child uses the numeral cards and either the dot plates from "Dot Pattern Match" or the picture sets from "Match It and Check It." The child randomly draws a dot plate or a picture set and then finds the correct numeral card to match. (3) One child holds up the correct numeral card after another child says each oral number name in random order.

5. ACTIVITY: Counting-on.

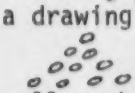
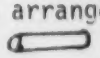
MATERIALS NEEDED: A set of sentence strips. Each strip has a set of 2-10 gummed stars affixed in a straight line. Each sentence strip also has a fold-over tab which covers a few stars of the set. On the tab is written the numeral which tells how many stars are beneath the tab: (see example below).

PROCEDURE: A child randomly selects a sentence strip and tries, by "counting-on", to determine the total number of stars on the strip. After the child predicts the number of stars, (s)he lifts up the tab and counts if (s)he wishes to determine if (s)he is correct.

SUGGESTED FOLLOW-UP: A good readiness activity for this activity is one in which one child chooses a numeral card at random and shows it to a second child The second child starts with the numeral shown and "counts-on" (or "counts-back").

6. ACTIVITY: Let's go bowling.

SKILL: Counts and Orders Sets, 0-10.

MATERIALS NEEDED: "Bowling pins" and a sheet of posterboard with a drawing showing the bowling pin arrangement  Cylindrical blocks  work well as bowling pins.

PROCEDURE: As the teacher counts, a child places "bowling pins" (one at a time) on the drawing. The drawing is filled from top to bottom and left to right. Subsequently the teacher shows pictures of bowling pin arrangements, e.g. and asks the children to count the bowling pins shown. Later, children are given the pictures of the bowling pin arrangements and are asked to put them in order from 0 to 10.

SUGGESTED FOLLOW-UP: (1) A child rolls a ball at the 10 bowling pins and tries to knock them down. After each roll the child counts the number of bowling pins still standing. (2) Two children use use the dot plates, from "Dot Pattern Match," the picture sets from "Match It and Check It," or the egg carton drawings from "Matching Eggs with numerals." The materials are divided

evenly between the two children and placed face down. Each child turn over a "set-card" and the children count the sets to determine which is greater. The child with the greater set collects both cards. Play continues until all cards are used.

B. Ordinal numbers

L. ACTIVITY: Line 'em Up.

SKILL: Using the ordinal number 1st through 5th.

MATERIALS NEEDED: Five pictures of horses running in a race; a finish line.

PROCEDURE: The horses are arranged in the order that they finish. a horse race described by the teacher. Then the teacher asks questions like "Which horse is the first one to cross the finish line? Which horse will be the second one to cross the finish line? Which horse came in fifth?" etc.

SUGGESTED FOLLOW-UP: Have five children line up to go out the door. Ask, "Who is first in line? Who is second?" etc. Then have each child turn so that it appears they are coming into the room. Again ask, "Who is first in line?" etc.

IV. Measurement (linear, volume, weight)

1. ACTIVITY: Matching objects of same lengths.

SKILL: Pre-measuring, matching and comparing lengths.

MATERIALS NEEDED: Sorting box filled with pairs of objects of different lengths (e.g. pencil and screwdriver, straw and yarn, toy car and spool.).

PROCEDURE: Child compares lengths until all objects are matched.

SUGGESTED FOLLOW-UP: Children may compare heights and widths (boxes, jars, bottles, etc.).

2. ACTIVITY: Comparing lengths.

SKILL: Premeasuring; developing concept of "longer than".

MATERIALS NEEDED: Sorting box filled with objects such as paper clip, comb, pencil, stick, crayon, rope, recording cards (------- longer than ----.).

PROCEDURE: Child compares objects and places the longer objects on the left side of the card and the shorter objects on the right.

SUGGESTED FOLLOW-UP: Using different recording cards and objects children can develop the concepts of "taller than" and "wider than".

3. ACTIVITY: Sorting boards.

SKILL: Matching, comparing and sorting to an arbitrary unit.

MATERIALS NEEDED: Three pieces of posterboard or paper plates for sorting, unit for comparison (orange cuisenaire rods or decimeter lengths are good) sorting box of "junk".

PROCEDURE: Child sorts into three categories "shorter than" unit, "about the same as" unit, "longer than" the unit.

SUGGESTED FOLLOW-UP: Use many arbitrary units such as scissors, pencil, crayons, chalk, etc.

4. ACTIVITY: Putting junk in order.

SKILL: Comparing, sorting, ordering height, length, and width.

MATERIALS NEEDED: Sorting box of "junk" such as small boxes (toothpaste, jello, aspirin, etc.), spools, pencils, etc.

PROCEDURE: Child puts materials in order from tallest to shortest, widest to narrowest, etc.

SUGGESTED FOLLOW-UP: Other size ordering games can be easily made from tagboard (e.g. gingerbread man, smiley faces, snowman, etc.).

5. ACTIVITY: How long is it?

SKILL: Measuring length with non-standard units.

MATERIALS NEEDED: Objects of equal lengths such as cubes, blocks, pencils, orange cuisenaire rods for the unit. Vegetables are especially fun - try squash, cucumbers, green beans, and carrots. Then make a salad.

PROCEDURE: Children explore measurement of length by lining up non-standard units next to the object to be measured. Example: Measure the length of a table using green beans,

or the length of the chalkboard using zucchini. Have the child state the unit. That is, the door is 7 zucchini wide.

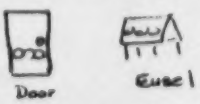
SUGGESTED FOLLOW-UP: Compare objects that cannot be compared directly such as a door and a window by lining up the measuring units to compare.

6. ACTIVITY: Make a chain for measuring.

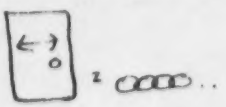
SKILL: Construction of a non-standard unit for measuring; Introduction to iteration.

MATERIALS NEEDED: Colored paper strips, stapler or tape.

PROCEDURE: Child constructs a chain from 10 paper strips, then uses it to measure objects in the room. Teacher can make picture tasks cards. (Children can guess the length prior to measuring.).



SUGGESTED FOLLOW-UP: Record the lengths of objects by pinning individual links to a bulletin board. See Graphing.



7. ACTIVITY: How far will 5 feet go?

SKILL: Estimating lengths before measuring.

MATERIALS NEEDED: Construction paper, posterboard, chalk, scissors.

PROCEDURE: Child traces his foot and cuts out 5 of his footprints. Then (s)he estimates how far the 5 feet will go and marks on the posterboard with chalk, then (s)he will go and measure the distance by laying the footprints in a line.

SUGGESTED FOLLOW-UP: Use other units such as paper clips, straws, chalk, etc.

8. ACTIVITY: Measuring with unifix cubes.

SKILL: Measuring with simple rulers.

MATERIALS NEEDED: Unifix cubes.

PROCEDURE: Have the child sort the cubes by color and connect each group. Measure objects around the room and break off the "ruler" to make it the same length as the object. The child can then count the cubes that are left.

SUGGESTED FOLLOW-UP: Centimeter cubes may be used for measuring. After the child has many experiences making the "ruler" the same length as the object to be measured, (s)he can count the cubes without first breaking the ruler.

9. ACTIVITY: Make a meter.

SKILL: Developing the concept of meter, constructing a measuring device, direct matching.

MATERIALS NEEDED: Meter stick, adding maching tape, scissors, crayons.

PROCEDURE: Child will cut a meter strip and decorate it with crayons, then find something in the room that is about one meter tall (long, etc.)

SUGGESTED FOLLOW-UP: Find objects that are shorter than a meter and longer than a meter. Children can record on butcher paper with crayons.

10. ACTIVITY: Metric Me - measurement.

SKILL: Measuring length with metric units.

MATERIALS NEEDED: Meter stick, centimeter rulers (white cuisenaire rods), centimeter height chart, paper for recording.

PROCEDURE: Either by teacher direction or picture task cards have the children find their "measurements". Length of foot, where a m reaches from floor to ___?___, height in cm, length of pinky, width of pinky, big toe, etc.

SUGGESTED FOLLOW-UP: Trace the child on butcher paper and have him/her paint and cut the figure. Label lengths of parts of the body and hang.

11. ACTIVITY: Measuring with "footsies".

SKILL: Measuring with a non-standard unit.

MATERIALS NEEDED: "Footsies" cut from pink paper (about 1 decimetre long), Recording sheet with each child's name, floor graph (masking tape).

PROCEDURE: Child lays on floor with feet on base line (tape). Friend lays "footsies" to the child head. Count and record.

12. ACTIVITY: Match the amounts.

SKILL: Matching and comparing volume.

MATERIALS NEEDED: Water, containers of different sizes but some of which have equal capacity.

PROCEDURE: The child will pour water from one container to another until (s)he finds two that hold the same amount.

SUGGESTED FOLLOW-UP: Have the child guess which two might hold the same amount. Make illustrated task cards that ask the child to find containers that hold the same amount.

13. ACTIVITY: Rubber band jars.

SKILL: Pouring to match water level (volume).

MATERIALS NEEDED: See - through plastic jars and containers, rubber bands, water, pouring cup or pitcher. After placing a rubber band around the jar.

PROCEDURE: The child will pour water into the jar up to the level of the rubber band around it.

SUGGESTED FOLLOW-UP: Place two or more rubber bands around the containers and have the child fill it to the 2nd or 3rd band.

14. ACTIVITY: Put containers in order.

SKILL: Sequencing capacity.

MATERIALS NEEDED: Boxes of 3 different sizes, rice, funnel, tub.

PROCEDURE: Have the children pour rice into one box and then from one box to the next until (s)he can see which holds the most.

SUGGESTED FOLLOW-UP: Using different shape litre containers, have the child discover by pouring that each different shape holds the same amount.

15. ACTIVITY: Green bean can levels.

SKILL: Comparing volume.

MATERIALS NEEDED: Empty green bean can, plastic containers of different sizes, water, water table or buckets, pouring cups.

PROCEDURE; The child will fill the green bean can with water and pour one can into each container and observe the different water levels.

16. ACTIVITY: How many cans?

SKILL: Estimating volume.

MATERIALS NEEDED: 4 oz. cups, quart jar or bottle container, water, water table.

PROCEDURE: Have the child guess how many cups a container will fill. Have him/her pour the water from the full container into the cups until the container is empty.

SUGGESTED FOLLOW-UP: Use other measuring units such as half-pint milk cartons, juice cans, etc.

17. ACTIVITY: Cups and quarts.

SKILL: Comparing cups and quarts.

MATERIALS NEEDED: One cup containers, quart jar, water, funnel, bucket.

PROCEDURE: Have the child fill the cup, pour it into the quart and repeat until the quart is full. Record by making a picture graph (see graphing activities).

SUGGESTED FOLLOW-UP: Do the same activity using rice, popcorn, macaroni, etc.

18. ACTIVITY: Balance the scale.

SKILL: Exploring concept of mass.

MATERIALS NEEDED: Balance scale; box of "junk" to balance.

PROCEDURE: Have the children balance the scale by putting-different pieces of junk on either side.

SUGGESTED FOLLOW-UP: Develop concepts of "ligher" "heavier" has "less mass than", "more mass than."

19. ACTIVITY: Milk carton balance.

SKILL: Comparing masses.

MATERIALS NEEDED: 6 empty ½ pint milk carton with rice (pairs having the same mass), balance.

PROCEDURE: Ask the child to estimate the masses by lifting and finding 2 that match. Have him use the balance to check.

SUGGESTED FOLLOW-UP: Let the children pour rice of macaroni into the cartons and try to balance the scale.

20. ACTIVITY: Tennis ball mass comparison.

SKILL Sorting and comparing masses.

MATERIALS NEEDED: Balance scale, box of "junk" sorting trays marked with "more than the ball: and "less than the ball:, tennis ball.

PROCEDURE: Have the child place the tennis ball on one side of the balance. Then have him put each piece of "junk" (one at a time) on the other side, and place it in appropriate sorting tray.

SUGGESTED FOLLOW-UP: Record the findings with pictures (see-graphing).

21. ACTIVITY: Balancing with cubes.

SKILL: Exploring mass with multiple non-standard units.

MATERIALS NEEDED: 1" cubes, box of "junk", balance, Construction paper cut in 1" squares, white paper strips (3"-12") for recording.

PROCEDURE: Have the child balance the scale using a piece of "junk" and the cubes. Then have him/her record by drawing a picture of his/her mass weighed and gluing the paper squares in a row next to the picture.

SUGGESTED FOLLOW-UP: (1) Gather the data from all the children and mount on butcher paper.

(2) Use other non-standard units such as blocks.

V. Graphing (bar graphs)

1. ACTIVITY: Graphing with objects.

   SKILL: Making comparisons between sets, developing concepts, equality.

   MATERIALS NEEDED: Butcher paper marked off in rows, objects to graph. Example: Shoes, boots, sneakers that the children are wearing.
   Other curriculum areas can be correlated with math. Try graphing things that a magnet will or will not pick-up during a science unit.

   PROCEDURE: Have the children, one at a time, lay their footwear in the appropriate row.

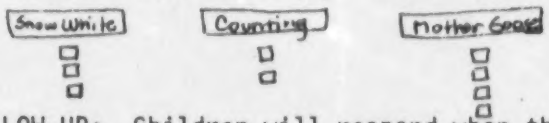
   SUGGESTED FOLLOW-UP: Illicit responses from the children. Which set has the most? The least? How many more boots than sneakers?

2. ACTIVITY: Graphing with objects voting.

   SKILL: Making comparisons, developing $<$ $>$ concepts, equality, 1 - 1 correspondence.

   MATERIALS NEEDED: Inch colored cubes.
   Records for the listening center.

   PROCEDURE: Line up three records. Hand one cube to each child and have them come, one at a time, and "build" in front of the record they want to hear.



   SUGGESTED FOLLOW-UP: Children will respond when they see that two columns are equal, one has more, etc.

3. ACTIVITY: Graphing with pictures.

   SKILL: Making comparisons between sets, developing concepts, equality.

   MATERIALS NEEDED: Butcher paper marked off in three rows and many columns, mittens, gloves, and hands cut from construction paper.

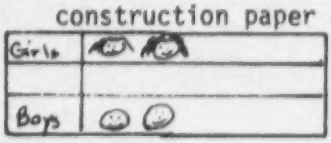
PROCEDURE: Have the paper graph hanging on the wall. Let each child glue a mitten, glove, or hand in the appropriate row according to what be wore to school that day.

SUGGESTED FOLLOW-UP: Use many different categories and pictures (pants & skirts; shoe styles).

4. ACTIVITY: Graphing with pictures.

SKILL: Making comparisons between sets, < > concepts, equality.

MATERIALS NEEDED: Circles cut from construction paper, 12" - 18" construction paper divided for graphing.



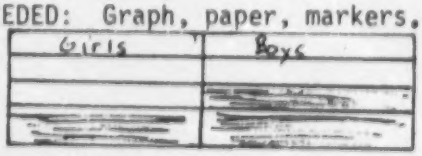
PROCEDURE: Have the children draw their face on a circle and glue it in the appropriate row.
Categories: bus riders, car riders, walkers
boys, girls
what you ate for breakfast
hair color - the children may enjoy gluing yarn hair on their face.

SUGGESTED FOLLOW-UP: Children can construct their own graphs at the art table.

5. ACTIVITY: Graphing - abstract bar graphs.

SKILL: Making comparisons between sets, < > concepts.

MATERIALS NEEDED: Graph, paper, markers.



PROCEDURE: Have each child color one square over the appropriate picture.

SUGGESTED FOLLOW-UP: Use for any classifications. Example: favorite center at school, bus number for bus-riders.

VI. Time and money

A. Time reference points

1. ACTIVITY: Creating time books.

SKILL: Time reference points.

MATERIALS NEEDED: Blank bound books, pens, markers, crayons, clock, and a calendar.

PROCEDURE: Use the clock to show the daily schedule of the classroom. The children may illustrate a book which shows the sequence of the day's events. *This procedure can also be used for holidays of the year, birthdays, etc.

B. Clocks

1. ACTIVITY: Matching clocks.

SKILL: Matching clocks indicating time on the hour.

MATERIALS NEEDED: Cards with pictures of clocks showing time on the hour (2 sets). One chair per child.

PROCEDURE: Tape one set of cards to the chairs. Another set is dealt to the children. Ask each child to look for the chair that has the same card as (s)he does.

2. ACTIVITY: Clock cake.

SKILL: Understanding numbers on the clock face.

MATERIALS NEEDED: Large recipe card, cake ingredients, tube of icing and 2 clocks.

PROCEDURE: Help the children bake and ice the cake. Use the tube of icing to create a clock face. A clock should be used as an example. Place the hands on the time the cake will be eaten.

D. Calendars.

1. ACTIVITY: Calendar bingo.

SKILL: Understanding calendars.

MATERIALS NEEDED: Old laminated calendar, spinner with days of the week, cards with numers 1-31, and bingo markers.

PROCEDURE: Give each child a page from the calendar as a bingo card. The caller spins the spinner for a day of the week and draws a number for the date. If the child has that particular day and date (s)he covers it with a marker.

2. ACTIVITY: Calendar Race.

SKILL: Understanding the calendar.

MATERIALS NEEDED: Large one month calendar, 2 markers, deck of cards or spinner with days of the week.

PROCEDURE: Ask each child to choose a marker and place it on the first day of the month. Player 1 spins the spinner or draws a card and moves to that day of the week. Player 2 follows the same procedure. The first to reach the end of the month is the winner.

D. Coin Recognition

1. ACTIVITY: Soft dart game.

SKILL: Coin recognition and values of coins.

MATERIALS NEEDED: 12 x 12 piece of felt. (Draw dart board on felt using pictures of coins instead of numbers.). Soft dart balls. Cards with pictures of coins.

PROCEDURE: Have the child draw a card and name the coin pictured. Then have him/her hit the same coin on the dart board.

SUGGESTED FOLLOW-UP: Use the same procedure with a second set of cards which have the values (10¢) written on them instead of the coin pictures.

2. ACTIVITY: Building banks (block center).

SKILL: Coin recognition and values of coins.

MATERIALS NEEDED: Play coins and unit blocks.

PROCEDURE: Tape play coins to unit blocks. Ask the children to build a bank using blocks with only one type of coin (example: a penny bank or a nickel bank.).

SUGGESTED FOLLOW-UP: Set up the bank in the dramatic play area.

VII. Part / whole relationships

A. Part / whole relationships of objects

1. ACTIVITY: Snack games.

SKILL: Developing an awareness of part / whole relationships in snack foods.

MATERIALS NEEDED: Apples, pears, oranges and other easily divided snack foods.
Cutting tool.

PROCEDURE: During a snack period, discuss the division of the fruit into component parts. Divide the fruit.

SUGGESTED FOLLOW-UP: Extend the activity to making sandwiches and other snack-related activities.

2. ACTIVITY: People parts.

SKILL: Developing an awareness of part / whole relationships relative to the body.

MATERIALS NEEDED: Mannequins, displaying individual body parts.

PROCEDURE: Discuss names of individual body parts. Have children place body parts in appropriate places.

SUGGESTED FOLLOW-UP: Continue discussion of individual body parts by having children name their own body parts. "Body part" fingerplays and songs can also be utilized.

3. ACTIVITY: Parquetry Games

SKILL: Developing an awareness of part / whole relationships.

MATERIALS NEEDED: Parquetry blocks and patterns.

PROCEDURE: Utilize parquetry games in showing a whole made from several parts.

SUGGESTED FOLLOW-UP: Vary parquetry patterns.

4. ACTIVITY: "Machine" parts.

SKILL: Developing an awareness of part / whole relationships in varying types of machines or equipment.

MATERIALS NEEDED: Discarded radios, typewriters, television sets, etc.

PROCEDURE: Maintain a "machine" center in the classroom where children may disassemble parts of a piece of equipment.

SUGGESTED FOLLOW-UP: Utilize working equipment to show results of the proper assembly of parts into a whole.

B. Part / whole relationships of pictures.

1. ACTIVITY: Whole / part picture game.

SKILL: Develop an awareness of the relationship between a picture and its parts.

MATERIALS NEEDED: Pairs of identical pictures which are familar to the children, cardboard backing, contact paper or laminating material.

PROCEDURE: Mount pictures on a hard backing. Cut a picture from each pair into several parts. Ask the child match parts of pictures to the matching whole picture.

SUGGESTED FOLLOW-UP: Prepare additional pictures which have more detail and which are cut into more parts as the child's skill increases.

2. ACTIVITY: Whole / part pizza picture game.

SKILL: Developing on awareness of the relationship between a picture and its parts.

MATERIALS NEEDED: Pizza board cut into varying size slices. Copy of the pizza board with matching size slices on heavy cardboard.

PROCEDURE: Ask the children to match the pizza pieces to the whole pizza board and later to construct the pizza separate from the board.

SUGGESTED FOLLOW-UP: Use the activity with other round items such as pies, balls, etc.

3. ACTIVITY: Self-correcting picture puzzles.

SKILL: Developing an awareness of the relationship between puzzle parts.

MATERIALS NEEDED: Teacher-made self-correcting puzzle games stressing given concepts as object / numeral correspondence.

PROCEDURE: Demonstrate use of the puzzles. Use them an an interest center activity.

SUGGESTED FOLLOW-UP: Use similar cards to stress additional concepts.

4. ACTIVITY: What's missing?

MATERIALS NEEDED: Pictures of faces, mounted on cards, with various facial attributes missing.

PROCEDURE: Ask the children to name missing facial parts.

SUGGESTED FOLLOW-UP: Use pictures of other objects such as cars, etc. with various attributes missing.

VIII. Operations

A. Same Amount (See I and III)

B. Combining sets

1. ACTIVITY: Wholes and parts.

SKILL: Combining sets.

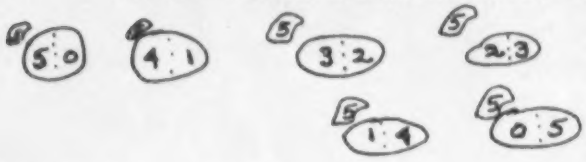
MATERIALS NEEDED: Small numeral from 0 through 10, ten counters, and a diagram like the one shown here:

The diagram should be large enough that all ten counters can be easily placed on either side of the dotted line and so that each numeral card will fit into the region drawn at the top.

PROCEDURE: The child randomly selects a numeral card and places it in the region drawn at the top. Suppose it is a 5. The task then is to find as many ways as possible to arrange 5 counters inside the loop - but not on the dotted line. The child has a set of smaller diagrams drawn on a sheet of paper and (s)he draws-in the counters to represent each new arrangement (s)he finds. For example the child would draw: This activity is repeated for the other numerals 0-10.

SUGGESTED FOLLOW-UP: (1) The teacher has a set of diagrams with counters drawn in. The child's task is to determine the numeral that goes with

each arrangement and then to write it in the space provided. (2) The procedure described in the main section above is repeated but the child writes the numerals in the diagrams instead of drawing-in the counters. Then the result for the set of 5 counters would be:

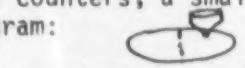


C. Separating sets

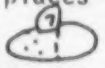
1. ACTIVITY: Parts and missing parts.

SKILL: Separating sets.

MATERIALS NEEDED: Small numeral cards, 3 cm x 3 cm, (two each numeral 0-10), tne counters, a small cup, and the following diagram:

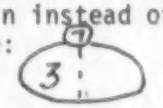


PROCEDURE: Two children do this activity together. The first player randomly draws a numeral card and places it in the region at the top of the diagram. The second player takes out the indicated number of counter and (while the first player closes his/her eyes) arranges counters inside the loop. Then (s)he places the cup over one of the two sets formed-like this:



The task for the first player then is to determine how many counters are beneath the cup. Children should be encouraged to "count-on" from the set of counters shown. This activity is repeated often.

SUGGESTED FOLLOW-UP: Diagrams are drawn on paper with numerals drawn-in instead of counters draw-in. For example:



The student is to write the correct numeral in the blank space. This activity is repeated often also. The child should be encouraged to use counters if (s)he wishes, but the ultimate goal is to be able to do the problems without using the counters.

RESOURCES

RESOURCES

Almy, M., et al. Young Children's Thinking. New York: Teacher's College Press, 1966.

Cahoon, O.W. A Teacher's Guide to Cognitive Tasks for Pre-school. Provo: Brigham Young University Press, 1977.

Croft, D., and Hess, R. An Activities Book for Teachers of Young Children. Boston: Houghton - Mifflin, 1975.

Day, B. Open Learning in Early Childhood. New York: Macmillan, 1975.

Devries, R., and Kamii, C. Piaget, Children and Number. Washington: National Association for the Education of Young Children, 1976.

Fleming, B., et al. Resources for Creative Teaching in Early Childhood Education. New York. Harcourt Brace, 1977.

Bridge, C., and Lemmon, K. Learning to Read My World: Language Experiences for Young Children. Kentucky Department of Education, 1979.

Ginsburg, H., and Opper, S. Piaget's Theory of Intellectual Development. Englewood Cliffs, N.J.: Prentice - Hall, 1969.

Guidelines for Kentucky Kindergartens. Kentucky Department of Education, Reprinted 1980.

Lavatelli, C. Early Childhood Curriculum: A Piaget Program. 2nd Edition, Teacher's Guide. Boston: American Science and Engineering, 1973.

Little, L. Directions: Guidelines and Curriculum Planning for Kindergarten Teachers. Lexington, Ky.: Educational Skills Development, Inc, 1973.

Lorton, N. Workjobs. Atlanta: Addison - Wesley, 1972.

Nuffield Mathematics Project Publications (Published for the Nuffield Foundation by John Wiley and sons, Inc., New York.

. . . Beginnings, 1967.
. . . Checking Up I, 1970.
. . . Computers and Young Children, 1972.
. . . I Do and I Understand, 1967.
. . . Mathematics: The First Three Years, 1970.
. . . Mathematics with Everything, 1971.
. . . Shape and Size, 1967.
. . . Your Child and Mathematics, 1968.

Richardson, L.I., et al. A Mathematics Activity Curriculum for Early Childhood and Special Education. New York: Macmillan, 1980.

Thornburg, K.R., and Thornburg, J.L. Metric Magic Atlanta: Humanics Limited, 1978.

APPENDICES

APPENDIX I: EQUIPMENT APPROPRIATE FOR THE KINDERGARTEN MATHEMATICS PROGRAM

The following are sample items which could be used in the kindergarten classroom.

color cubes and patterns
balance scale
Cuisenaire rods
unit blocks
parquetry blocks
calendar
lotto games
thermometers
dominoes
sets of ordering objects
counting containers and counters
graphing materials
measuring tools
old telephones
manipulative games
sequencing puzzles
formboards
classification (sorting containers and objects)
play money
counting beads
flannelboard cut-outs
tactile numeral cards
clocks
pattern devices
geometric shapes
books with math-related themes

APPENDIX II: SAMPLE OBJECTIVES FOR

A KINDERGARTEN MATHEMATICS PROGRAM

1. Given an attribute, choose an object that has that attribute.
2. Given two objects and an attribute, state whether the objects are the same or different on that attribute.
3. Given an object, describe it.
4. Given two objects, compares them on the attribute of length.
5. Given two objects, order them on the attribute of length.
6. Given three or more objects, orders them on the attribute of length.
7. Given an object, physically represents a length of that object.
8. Given two lengths and a physical representation of at least one of them, compares and orders the lengths of the basis of their physical representation.
9. Given two points and a movement between them, physically represents the movement.
10. Given two points and a movement between them, pictorially represents that movement.
11. Given two sets, compares and orders the sets on the attribute of numerousness.
12. Given a description of a shape, chooses a three-dimensional object that has that shape.
13. Given a three-dimensional object, describes its shape.
14. Given a set, pictorially represents the numerousness of the set.
15. Given two or more sets and their pictorial representations, compares and orders the sets based upon their pictorial representation.
16. Given a set with 0 - 10 objects, represents the numerousness of that set by stating the appropriate numeral.
17. Given a spoken or written number 0 - 10, represents it physically or pictorially.
18. Given a numeral 0 - 10, reads it.
19. Given a set of 0 - 10 objects and a set of numerals, represents the numerousness of the set by choosing the appropriate numeral.

Note: This list is not designed to be used as an exhausitive list of objectives for a kindergarten mathematics program.

APPENDIX III: SKILLS CONTINUUM FOR KINDERGARTEN

DISSEMINATED BY THE KENTUCKY

DEPARTMENT OF EDUCATION

I. Numeration

A. Develop pre-number concepts by:

1. Sorting by one or more characteristics (color, shape, size).
2. Ordering by size, weight, color, texture, volume.

B. Introduce the concept of cardinal numbers:

1. Use one-to-one correspondence to compare sets.
2. Use concrete objects to develop the concept of number amounts 0-9.
3. Attach oral names to sets 0-9.
4. Write numerals to match sets 0-9.
5. Count and order sets of 0-9.
6. Recognize numerals 0-9.

C. Introduce the concept of ordinal numbers.

D. Recognize positions first through ninth.

II. Number Theory

A. Use patterns to develop pre-number concepts:

1. Copy patterns.
2. Extend patterns.
3. Create patterns.
4. Compare patterns.
5. Contrast patterns.

B. Recognize sets and subsets.

C. Introduce vocabulary: sets, subsets, counting, half, whole, first second, third, fourth, fifth, sixth, seventh, eighth, ninth, pattern, like, different

III. Operations on whole numbers

A. Combine sets of concrete objects.
B. Separate sets of concrete objects.

IV. Operations on Rational Numbers

A. Introduce the concept of a whole thing.
B. Introduce the concept of fractional parts of a whole.
C. Recognize one-half of a whole.

V. Problem-Solving and Estimation

Use one-to-one correspondence to determine equivalent or non-equivalent sets.

VI. Calculator Skills: Computer Literacy

A. Use counting frames to show amounts.
B. String beads to show amounts.

VII. Approximation and Measurement

A. Introduce measurement through:

1. Non-standard units.
2. Simple tools.

B. Introduce the concept of time through:

1. Time reference points (lunchtime, birthdays)
2. Time sequence (Finish work; then have snack)
3. Time relationships
4. Manipulations of egg timers, model clocks, and other timekeeping devices

C. Develop a general awareness of days, weeks, months, years,

D. Develop an awareness of temperature.

E. Recognize penny, nickel, and dime.

F. Develop vocabulary for measurement:

1. Longer; longest
2. Shorter: shortest
3. Taller; tallest
4. Nearer; nearest
5. Farther; farthest
6. Same size as
7. Greater than
8. Less than
9. Same
10. More
11. Less

VIII. A. Develop an awareness of spatial relations:

1. Positions (over, under, between, horizontal, vertical, diagonal, before, after)
2. Directions of movement (clockwise, counterclockwise, forward, backward, up, down, to the right, to the left, around, in, out)

B. Recognize simple geometric shapes:

1. Square
2. Rectangle
3. Circle
4. Triangle

C. Recognize line segments:

1. Straight
2. Curved
3. Broken
4. Solid

D. Differentiate between open and closed figures.

E. Examine and describe geometric solids.

IX. Construct simple bar graphs with blocks, graduated rods, and other concrete materials.